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THE IRIDESCENT FELDSPARS

TO the physicist interested in the structure and properties of crystalline solids, the feldspars offer themselves as a fascinating field for study and research. Being a most important group of rock-forming substances, they have naturally been the subject of numerous painstaking investigations by mineralogists. A great volume of data concerning them has accumulated, and much of this awaits interpretation in terms of structural theory. Of particular interest is the optical behaviour of the feldspars. This includes a variety of attractive phenomena for which no satisfactory explanation has hitherto been forthcoming. Amongst them may be mentioned particularly the brilliant play of colours exhibited by the species of feldspar known as labradorite, which is found not only in the locality from which its name is derived, but also in various other parts of the world. Another group of feldspars known as the moonstones has found use in jewellery by reason of a beautiful optical effect known to mineralogists as "schiller" which they display. There are also other types of feldspar which display characteristic optical effects, *e.g.*, peristerite, murchisonite and amazonite. Labradorite and the moonstones have been the subject of two recent memoirs* published in the *Proceedings* of the Indian Academy of Sciences. Further papers dealing with other types of iridescent feldspars are scheduled to appear in the same journal in the near future. It is felt, however, that the results so far obtained are of sufficient general interest to justify the publication of a review article in *Current Science*, presenting this field of research in its broadest aspects.

Chemical analysis shows that apart from minor impurities present as inclusions, the commoner feldspars may be regarded as admixtures of three components having a definite composi-

* "The Structure of Labradorite and the Origin of Its Iridescence," by Sir C. V. Raman and A. Jayaraman, *Proc. Ind. Acad. Sci., A.*, 1950, **32**, 1–16.

"The Structure and Optical Behaviour of the Ceylon Moonstones," by Sir C. V. Raman, A. Jayaraman and T. K. Srinivasan, *Ibid.*, 1950, **32**, 123–40.

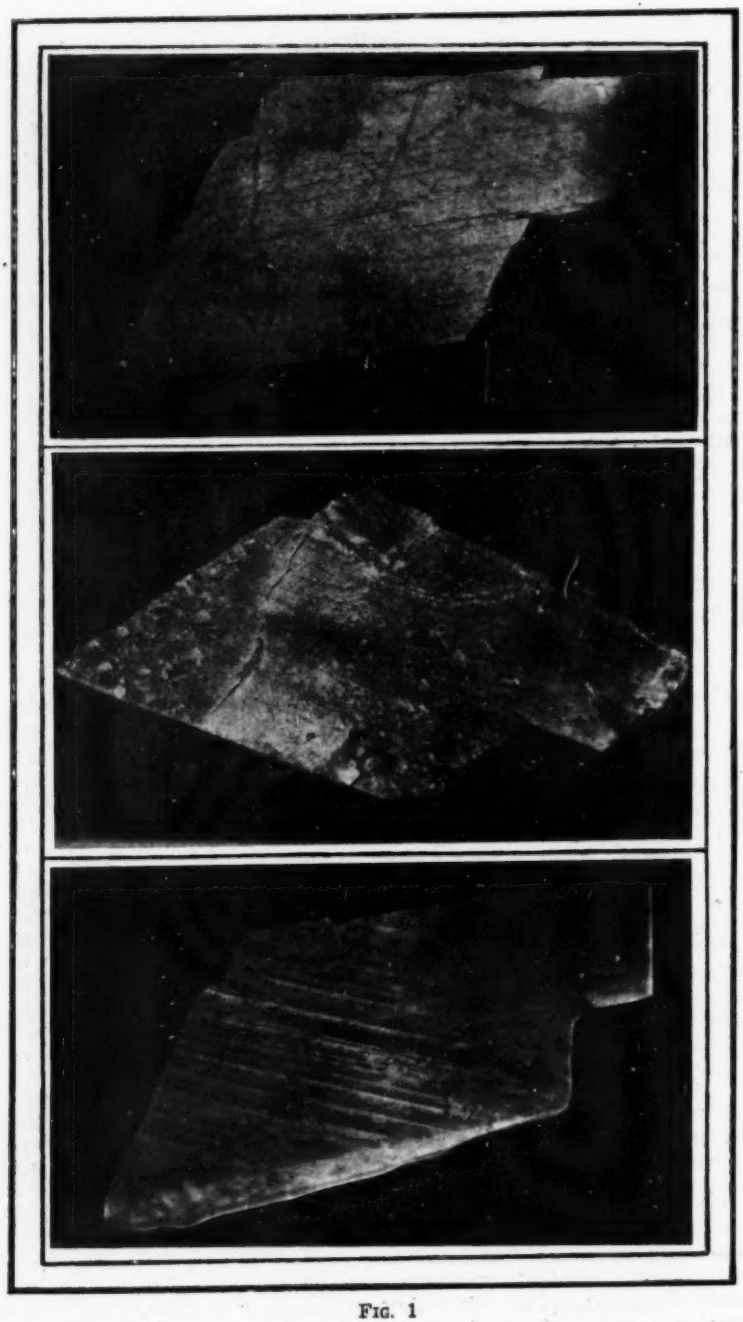

FIG. 1

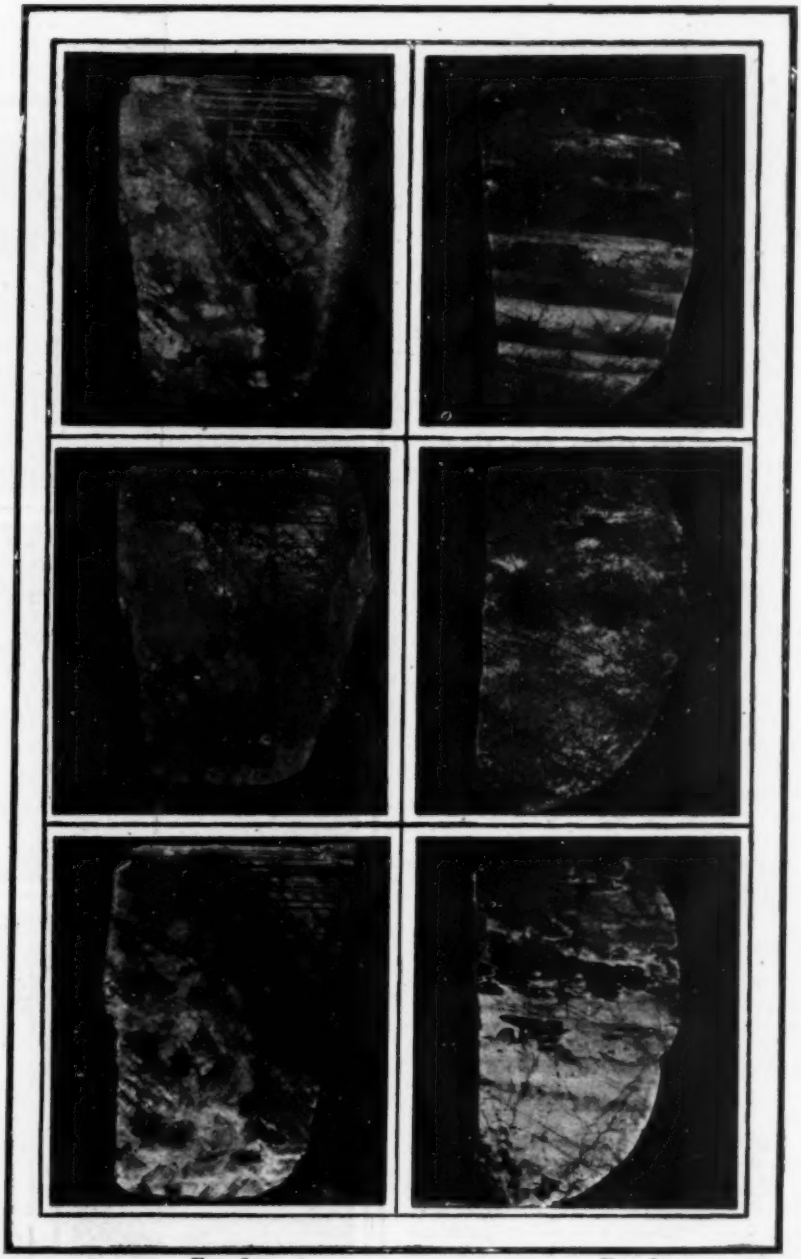

FIG. 2 FIG. 3

tion, namely the potash, soda and lime feldspars. Their mineralogical names and chemical formulæ are respectively orthoclase ($KAlSi_3O_8$), albite ($NaAlSi_3O_8$), and anorthite ($CaAl_2Si_2O_8$).

In their external aspect as well as in the internal structure revealed by X-ray studies, all the feldspars possess certain features in common. Nevertheless, there are important differences. In particular, we remark that while the chemical formulæ of orthoclase and albite are similar, the replacement of the monovalent alkali ion by the divalent calcium ion in anorthite is accompanied by a simultaneous replacement of a silicon atom by an aluminium atom. In spite of such replacement, albite and anorthite resemble each other in their crystal forms very closely, both being triclinic, while orthoclase is a monoclinic crystal. The explanation which has been given for this remarkable situation is that the replacement of silicon by aluminium does not involve any alteration in crystal structure, while on the other hand, the replacement of the larger potassium ion by the smaller sodium or calcium ion results in a definite change of structure.

It has been stated above that a naturally occurring feldspar usually contains all the three components. Their relative proportions, however, vary considerably. Labradorite, for instance, is principally a mixture of albite and anorthite in roughly equal molecular proportions, but contains in addition an appreciable proportion of orthoclase. The Ceylon moonstones consist principally of orthoclase, but include also a substantial proportion of albite and a small percentage of anorthite. In view of the differences in chemical composition and crystal structure of the three components in their pure state, the question naturally arises of the precise nature of their admixture in any particular feldspar as found in nature. In the two papers under reference, it has been shown that the answer to this question is furnished by the optical behaviour of the material under study. In other words, the play of colours exhibited by labradorite, and the schiller of moonstones are alike the optical consequences of the manner in which the component feldspars are distributed within the respective minerals. In the common or macroscopic sense, both labradorite and moonstones are monocrystals. But the passage of a beam of light through the mineral and the diffusion of light resulting therefrom reveal the existence of optical heterogeneity, in other words, of local variations of composition and refractive index. The observed characters of the diffused light, *viz.*, its spectral nature, intensity, state of polarisation and distribution in different directions, and their variations with the setting of the crystal and the direction of passage of light through it, furnish us with the data needed to infer the nature of the local heterogeneities within the crystal. The explanation of the optical phenomena presented by these feldspars thereby ceases to be a matter for conjecture or specula-

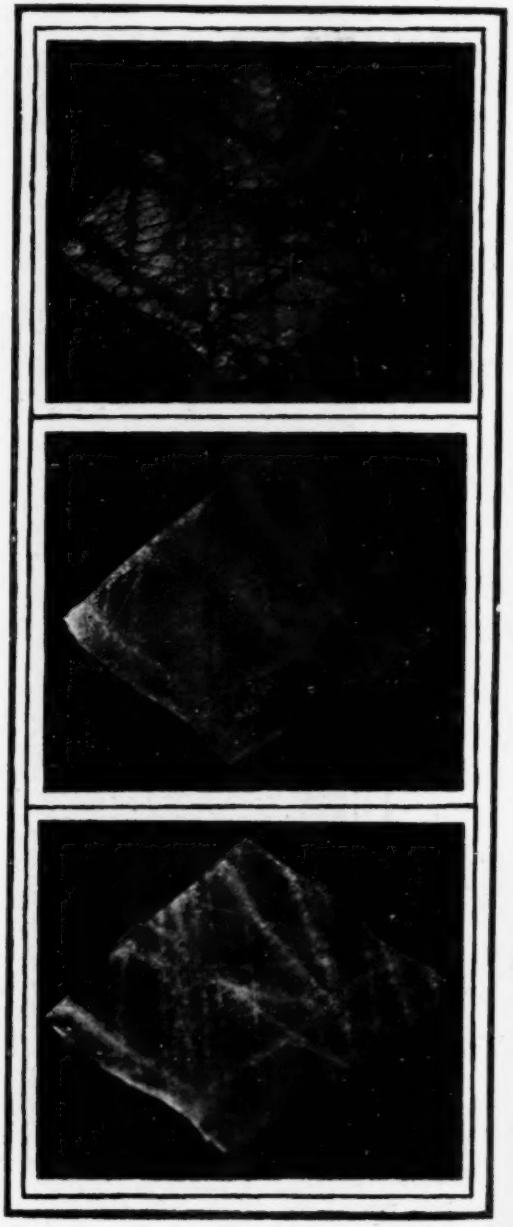

FIG. 4

tion and rests instead on a solid basis of observation and inference.

The optical behaviour of a mixed crystal is, of course, not comparable in all respects with that of a mixture of liquids. Nevertheless, it is useful to indicate the resemblances between the optical phenomena under consideration and the diffusion of light in binary and ternary liquid mixtures. The blue schiller exhibited by the finest moonstones may, indeed, be not inaptly compared in its origin and in its spectral character with the blue opalescence which develops in a binary liquid mixture, *e.g.*, of methanol with carbon disulphide, as its critical solution temperature is approached. The schiller is essentially a diffusion of light within the feldspar. It results from the segregation of the albite from the orthoclase in the form of tiny crystallites which so dispose themselves that the crystalline order and symmetry of the parent mass is left unimpaired. The blue colour exhibited by many specimens of labradorite may similarly be compared with the blue opalescence which develops when water is added to methanol containing benzene in solution, and the benzene tends to separate out in consequence. The diffusion of light in the labradorite which manifests as its iridescence is due to tiny crystallites of orthoclase which have segregated from the albite-anorthite mixture and set themselves in an appropriate orientation within the crystal lattice.

The interested reader will naturally refer to the original papers for further information regarding the topics dealt with above in their barest outlines. They contain a description and discussion of many facts of interest discovered in the course of the studies and which considerations of space preclude even being mentioned here. The illustrations accompanying the present article are taken from the paper on labradorite and represent four of the numerous specimens studied. As the reproductions are not in colour, they are not very effective as pictures of the beautiful phenomena actually observed. But they demonstrate a most important feature of the optical behaviour of labradorite, namely that it shows its characteristic iridescence in *two* different settings of the crystal with reference to the direction of the incident light. These settings (A and C in each figure) lie one on either side of the setting (B in each figure) at which the aventurinism due to the macroscopic inclusions is most prominently displayed. The parts of the labradorite which exhibit the iridescence in the two settings are different, being respectively the alternate layers of multiple twinning in the mineral. The distribution of these layers as well as the nature of the twinning is very different in the four specimens. This becomes evident in the iridescence displayed by them.

C. V. RAMAN.

SYMPOSIUM ON THE HISTORY OF SCIENCE IN S. ASIA

THE Council of the National Institute of Sciences of India, in collaboration with the UNESCO South Asia Science Co-operation Office, propose to hold this year in Delhi a Symposium on "The History of Science in South Asia". The dates provisionally fixed are 5th, 6th and 7th November, 1950.

The Symposium, which will cover the period up to the end of the 18th century, will deal with—

1. (*a*) Chronology of the achievements;
   (*b*) Defining the periods of achievements;
2. Life stories of the pioneers;
3. Contacts with outside on countries' own initiative or by the adventurous trips of foreigners;
4. General history of those periods with stress on social conditions;
5. Impact of the discoveries of the scientists on military strategy of the kings and on the general living conditions like town planning, public health, agriculture, transport, industries.

The papers contributed will give either a general integrated picture of scientific development in related branches of science, or a treatment of the progress through the different periods of history of one particular branch of science. They will also bring out the impact of science on society in various periods of history.

WORLD POWER CONFERENCE IN NEW DELHI

MORE than 20 British delegates will be taking part in the second post-war sectional meeting of the World Power Conference which is to be held in Delhi next January. Many of the delegates will also be attending the meetings of the International Commission on Large Dams which will hold its fourth Congress at New Delhi at the same time.

Among the British delegates will be Sir Vincent de Ferranti who has recently succeeded Sir Harold Hartley as Chairman of the International Executive Council and the British National Committee of the W.P.C.; Lord Citrine, Chairman of the British Electrical Association; Sir Arthur Fleming, of Metropolitan-Vickers Company; Mr. J. W. Warnock, hydro-electric engineer; and Dr. E. C. Fairhead, of Imperial Chemical Industries, Ltd.

Next year's Conference will have as its theme the "Utilisation of Power in its Various Aspects" and it is hoped that it will produce much valuable information on the development and use of power for the production of food and essential industries throughout the world. Some of the subjects on the agenda deal with such aspects of this theme as "Utilisation of Electricity in Agriculture and Agricultural Processing", "Electricity and Fertilisers", and "Power and Mines".

India has one of the most comprehensive irrigation systems in the world—the acreage under irrigation in India actually exceeds the combined total acreage irrigated in the U.S.A., the U.S.S.R., Japan, Egypt and Italy. Representatives from 32 nations have been invited to the Conference and various non-member countries of Asia will be sending unofficial delegates.

A special feature of the Conference will be an international exhibition arranged by the National Committee to demonstrate engineering activities relating to the utilisation and conservation of water power and allied research. The exhibition will include working and still models of river valleys and power works and will last for at least one month.

The Conference itself will remain in session for a week from January 10 to 15, but there will be opportunities for the delegates to take part in both pre- and post-Conference study tours of places of special interest.

GEOLOGY AT ALIGARH

A DEPARTMENT of Geology has been created at Aligarh University and Dr. P. N. Ganju has been appointed Reader and Chairman of the new department. Dr. Ganju has recently returned from King's College, Durham University, where he specialized in coal petrology.

The importance of trained geologists in India needs no emphasis; a great deal remains to be done in developing and exploring the mineral resources of this vast country. But at the moment very few Indian universities have well-equipped geological laboratories and perhaps none is equipped for research in coal petrology. Dr. Ganju's appointment will help to initiate research in this new and essential field so indispensable for the investigation of our coals and coal fields.

DR. R. R. WILLIAMS VISITING INDIA

DR. R. R. WILLIAMS of the Research Corporation of America, well known for his synthesis of vitamin B_1 and, till recently, Director of Research of the Bell Telephone Laboratories, is shortly undertaking a tour of South Asia, primarily to study the rice economy and practices of the rice-eating countries, to develop further knowledge of the extent of vitamin deficiencies and the applicability, for their correction, of undermilling, parboiling or artificial fortification methods. Dr. Williams will be in India during November 13 to December 13 under an appointment as Consultant to the U.S. Public Health Service and under the auspices of the Williams Watermann Fund for Cambat of Dietary Diseases. While in India, Dr. Williams will visit important research centres including Bombay, Delhi, Calcutta, Cuttack, Madras, Bangalore, Mysore and Coonoor as well his birth-place Nellore.

WORLD AGREEMENT FOR ABOLISHING DUTIES ON SCIENCE EQUIPMENT, BOOKS AND FILMS

SCIENTIFIC instruments, apparatus and collections intended for education or research will enjoy duty-free entry under a new international agreement which UNESCO is sponsoring as a means of reducing barriers to world trade in educational, scientific and cultural materials. The text of the convention was approved by UNESCO's 59 Member States attending the recent General Conference of the Organization in Florence.

The "Agreement on the Importation of Educational, Scientific and Cultural Materials" will also permit the free import of books, newspapers, periodicals, maps and charts. To aid their circulation further, contracting Governments will grant licenses and foreign exchange for publications consigned to public libraries. A special article in the convention provides for the duty-free entry of all books and other educational material for the blind.

Duties will also be lifted from educational, scientific or cultural films, filmstrips, newsreels and sound recordings. Paintings, drawings and sculpture will likewise be freed from tariff restrictions.

Scientific instruments and apparatus will enjoy exemption provided, firstly, they are intended solely for educational or research purposes and are destined for recognized educational or scientific institutions; secondly, that materials of equal scientific value are not already being manufactured in the importing country. Other materials which will be admitted duty-free, if consigned to approved institutions, include patterns, models and wall charts; and architectural, industrial or engineering plans and designs.

UNESCO is circulating the convention to all its Member States, and to Members of the United Nations. It will be open for signature at Lake Success, New York, shortly and will come into force following ratification by ten countries.

The United Kingdom Government has announced that it will submit the text to Parliament for ratification. Belgium, France, Luxembourg, the Netherlands and Switzerland are among other countries which are expected to take quick action for legislative approval.

Following its adoption at Florence, the Director-General of UNESCO, Dr. Jaime Torres Bodet, said the new world pact represented a substantial contribution, in the technical field, to mutual understanding and peace. He urged swift action to bring it into force.

This is the second international agreement to be sponsored by UNESCO. The first, which is designed to abolish duties, quotas and licenses hindering the movement of films, recordings and other audio-visual aids to education, has now been signed by 18 countries and ratified by three (Norway, Yugoslavia and Pakistan).

Both conventions are expected to be of considerable aid to importers and exporters in countries taking part in UNESCO's International Coupon Scheme, since they will lift tariff and other restrictions on materials which the scheme covers—books, periodicals, scientific materials and educational or scientific films. This plan, which was initiated as a book scheme in December 1948, has been extended to scientific materials and films since January 1950. It enables institutions or individuals in soft currency countries to buy these items from hard currency countries, while making payment in their own national currency.

Nineteen countries are now taking part in the book phase, ten in the scientific materials phase and twelve in the film phase of the scheme. Scientific material purchased is for the time being limited for the use of educational and scientific institutions. A leaflet issued by UNESCO gives a list of materials in 11 categories that can be bought, together with the addresses of suppliers. These materials include chemicals, glass and porcelain.

—By courtesy of UNESCO.

GROUND TRAFFIC CONTROL FROM THE AIR

THE utility of the "mobilophone" service was demonstrated on the occasion of the 25th Anniversary of the Dutch Broadcasting Association at Hilversum. A fixed mobilophone set was stationed at Police Headquarters, while 6 mobilophone-equipped cars drove through Hilversum to report possible traffic jams. In addition, a sports-plane equipped with Philips mobilophone cruised above Hilversum, to give instructions, also from the air. In this way the entire traffic control could take place from one central point (Police Headquarters).

FISH CULTIVATION IN OPEN SEA-LOCHS

NOTHING is of greater interest to chronically under-nourished countries facing persistent food shortages over a period of years than successful methods of cultivating food materials of whatever kind on every available inch of land or water. During World War II, well-regimented Great Britain, faced with the prospect of starvation consequent on its lines of sea communication with the rest of the world being cut, not only encouraged all possible economy and means of prevention of waste in food conservation, storage, and distribution, but stimulated new methods of production from the natural resources within the country.

A group of zoologists of the Edinburgh University carried out experiments, with liberal financial grants from the Imperial Chemical Industries, Ltd., in applying fertilizers to the Scottish sea-loch, Loch Craiglin, with the object of testing "the possibility of increasing fertility of a small sea-loch by the addition of nitrate and phosphate fertilizers, with a view of improving the growth rate and yield of fish." The results of the experiments were sufficiently encouraging not only to deserve publication,* but also to justify an extension of the work to a larger area of Loch Sween, of which, Loch Craiglin formed only a very small and atypical part. Kyle Scotnish, a much larger area of Loch Sween than Loch Craiglin, in which the extension work was carried out, had certain advantages, (1) in having a sufficiently large volume of water to reduce the extreme fluctuations in salinity, pH, and other factors encountered in the previous experiments, (2) in having sufficient depth to reduce the proportion of seaweed to phytoplankton in the productivity of the cultivated area, (3) in having its connections with the main loch intact to enable tests of possibilities of fertilizer application to open, instead of artificially enclosed, sea-lochs being carried out.

The results of the extension experiments, like those of the original experiment, though concerned primarily with the scientific rather than the economic problems of marine pisciculture, were considered to be of sufficient importance to form a series of five articles in a recent issue of the *Proceedings of the Royal Society of Edinburgh*, LXIV, B. Part I, 135 pp. (1949-50). These articles deal with the hydrographic factors, the plankton, the bottom fauna, and the growth of fish in Kyle Scotnish under the fish cultivation experiments carried out in this arm of Loch Sween. Following the application of fertilizers (superphosphate, sodium nitrate, or ammonium sulphate) to Kyle Scotnish with its connection with the main loch left open, one and a half million eggs and fry of plaice and flounders obtained from an adjoining hatchery were released in 1945-46 and their growth observed. The experiments have shown that these fish grow three to four times as fast as the fish in normal grounds. The results of the experiments do not throw any light on whether marine cultivation can be made to pay, but before properly planned experiments dealing with the economic aspects can be carried out it seemed essential to the sponsors of these experiments to gather much more information "regarding the chain of events following the application of fertilizers, the magnitude of the response of the different plant and animal communities, and the growth-rate and migratory movements of fish in an open area".

There is a crying need for such experiments being carried out in our coastal lagoons and backwaters in India even in these times of tight financial conditions, because area for area water appears to be more responsive to fertilizer treatment than land and to offer better chances of higher yields over a longer period of time with less labour and capital than are required for land cultivation. It is unfortunate that the chronically starved biological research organizations of our Universities and under the control of our States and Central Governments have to wait indefinitely for better times to follow the lead given by Great Britain and other countries.

H. SRINIVASA RAO.

* *Proceedings of the Royal Society of Edinburgh*, **B. 63, (1)**, 1947; *Journal of the Marine Biological Association, Plymouth*, **28, Part 1, 1949.**

FELLOWSHIP AWARD

DR. K. K. MAJUMDAR, M.SC., D.PHIL. (Cal.), A.R.I.C. (Lond.), Senior Lecturer in Mineral Dressing, Indian School of Mines and Applied Geology, Dhanbad, has been awarded the Willam Campbell Fellowship by the Columbia University, New York, and the Fulbright Travel Grant by the U.S.A. Government. Dr. Majumdar will carry on researches on flotation of minerals under Prof. A. F. Taggart in the Department of Mineral Engineering in the Columbia University.

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SUPPRESSION OF HIGH FREQUENCIES IN THE PRODUCTION OF *JOSHI EFFECT*

A review of the now considerable literature on this phenomenon shows, (1) the presence in the discharge current of numerous frequencies much higher than that of the exciting field;[1] (2) exposure of the discharge tube to light causes a current decrease, $-\Delta i$ (the negative *Joshi Effect*), and (3) which predominates in the H.F.'s.[3,5,6,8] No satisfactory explanation is forthcoming for (3). The mechanism of Klemenc, *et al.*[2] for H.F. production in the ozoniser discharge cannot explain Joshi Effect, since it does not anticipate the occurrence of the positive effect, negative temperature coefficient, the influence of the nature of the gas and of 'ageing'.[9] The boundary complex theory (*vide infra*) gives a more detailed mechanism of the working of the boundary layer, postulated by Joshi[9] as the chief seat of the effect, and is not inconsistent with the findings of Klemenc, Hintenberger and Hoffer.[2] It is suggested that (4) the formation of a single-bonded [10,11,12] polarised wall complex, $W^{+\frac{1}{2}}.(XY)^{-\frac{1}{2}}$ is a primary step, where W denotes the wall molecule and XY the gas molecule from the discharge space which can accept normally or under excitation an electron donated by W; (5) under the applied fields the complex ionises: $W^{+\frac{1}{2}}.(XY)^{-\frac{1}{2}} \rightarrow (W\,XY)^{+} + e(-)$; (6) light dissociates it into neutral particles (*a*) W+XY, (*b*) WX+Y or/and particles (*a*) W+ XY, (*b*) WX + Y or/and negative ions, (*c*) $W^{+}+XY^{-}$, (*d*) $WX^{+}+Y^{-}$ instead of electrons in (5); the latter causes a

current decrease represented by negative Joshi Effect. On this view electrons initiate the current in dark and negative ions do so under light. Thus there are in the two cases (5) and (6) differences in respect of velocity and number of current carriers and the ionising power of the current initiators, *viz.*, electrons in (5) and negative ions in (6). This accounts for the photo-diminution, $-\Delta i$.

On this basis, the suppression of the associated H.F.'s, in terms of Klemenc, *et al.*'s theory originates as follows: Comparatively, a greater proportion of surface charges is formed with free electrons in dark. Under light from (6) neutral particles or/and negative ions are released, these last possess a markedly lower ionising efficiency. The corresponding surface charges produced will consist chiefly of negative ions and electrons. Their neutralisation, therefore, would yield weaker pulses under light than in dark, where the surface charge density is greater due to presence of free elctrons (with their more intense ionising power) from (5). The reduced strength of the H.F.'s under light, therefore, follows.

We can view the problem from another standpoint. An ozoniser can be considered as a condenser[4] discharging internally. Under light the ionisation is reduced; the corresponding capacity and especially resistance become greater than in dark. A decrease in frequency should, therefore, follow since to a first approximation $f = (1/2\pi).\sqrt{(1/LC - 4R^2/L^2)}$, where f denotes not the resonant frequency but Σf the equivalent frequency.[4] Joshi observed[5,7,8] that $-\Delta i$ is reduced numerically by the introduction of a serial resistance in the circuit, which was ascribed by him to a preferential damping of the H.F.'s. This last should also occur under light since i diminishes, indicating increase in resistance.

We wish to express our gratefulness to Prof. S. S. Joshi, Principal, Science College, Hindu University, Banaras, for encouragement and help in writing this note.

Chemistry Depts., Hindu University, Banaras, and Muslim University, Aligarh, *April* 6, 1950.

M. V. RAMANAMURTI.
S. SHAMIM AHMAD.

1. Warburg and Leithauser, *Ann. Physik*, 1903, **28**, 1. 2. Klemenc, Hintenberger and Hoffer, *Z. Electrochem.*, 1937, **43**, 708. 3. Joshi, *Curr. Sci.*, 1945, **14**, 67. 4. —, *ibid.*, 1947, **16**, 19. 5. —, *Proc. Ind. Acad. Sci.*, 1945, **22A**, 389. 6. —, *ibid.*, 1945, **22A**, 225. 7. —, *Presi. Addr. Ind. Sci. Cong.*, 1943. 8. —, *Nature*, 1944, **154**, 147. 9. Ramanamurti, *J. Ind. Chem. Soc.*, 1948, **25**, 255. 10. Shamim Ahmad, *Proc. Ind. Sci. Cong.*, 1948, *Chem. Sec.*, **A19**. 11. Ingold, *J. Chem. Soc.*, 1926, 1315. 12. Sugden, Parachor and Valency, Routledge, *ed.* 1930, **0**, 131.

RADIATION CORRECTION AND THE LAW OF COOLING

IN a recent note, Gupta[1] has compared the relative rates of heat loss by a cooling body as calculated from the Stefan's Law on the supposition that the body behaves as a perfect black body and that from Newton's Law of cooling. He finds that, for a difference of temperature of about 5° C. between the body and the surroundings, the contribution of radiation loss is about 75 per cent. and of convection about 25 per cent. The experiment was performed by suspending a calorimeter inside a bigger vessel by means of threads.

We have performed the experiment under different conditions. A calorimeter was supported inside a double-walled bigger vessel by means of an ebonite disc having a central hole and covering the bigger vessel. The enclosure temperature was kept constant by keeping water flowing through the outer jacket. In order to minimize the temperature gradients in the upper parts of the walls, the calorimeter was filled with water to the same level, nearly to the top, in all the experiments. Table I shows the results obtained.

TABLE I

Temperature of the absorbing surface		Rate of loss of heat at 43°C.	at 40 °C.	at 38·6°C.	Nature of the surfaces: Cooling	Nature of the surfaces: absorbing
(i) 34·3 °C	S	64630	41570	29540	dull white	dull black
	N	75730	45810	31340		
(ii) 33·0 °C	S	69164	41751	39966	unpolished	unpolished
	N	54890	33920	26360		
(iii) 32·2 °C	S	75587	53909	44389	polished	unpolished
	N	59570	39970	39660		
(iv) 33·0 °C	S	69164	41751	39966	dull black	unpolished
	N	74980	43550			

S = Stefen's Law (calculated) ergs/sec/cm^2/T^4

N = Newton's Law (experimental) ergs/sec/cm^2/T

It is found that in no case do the values, for the relative rates of heat loss calculated from

Stefan's Law and those found experimentally by applying Newton's Law of cooling, agree. The term 'radiation correction' as used in connection with such experiments in calorimetry, therefore, seems basically wrong and misleading; instead 'cooling correction' should be the proper term used. It is further seen by comparing the cases (*i*) and (*iv*) with (*ii*) and (*iii*), that the rate of loss of heat is much more in the former case than in the latter. It is therefore advisable to keep the cooling surface dull instead of polishing[2] it for quicker cooling. It is also apparent that taking the convection loss to be the same at a particular temperature (though it is different at different temperatures) in all the cases, the loss by radiation depends on the nature of the cooling as well as the absorbing surfaces. It is therefore desirable to define the specific conditions under which the Newton's Law of cooling experiment be performed.

We are thankful to Dr. H. R. Sarna for his kind encouragement and guidance.

P.U. Physics Dept., Govt. College, Hoshiarpur (Punjab), *July* 28, 1950.

OM PRAKASH.
SHADI LAL.
BALDEV SINGH.

1. Gupta, M. R., *Curr. Sci.*, 1950, **19**, 113. 2. Ingles, A. R., *Amer. Jour. Phys.*, 1950, **18**, 194.

ELECTRO-DEPOSITION OF METALS AND ALLOYS FROM CYANIDE-FREE BATHS

Part II. Copper from Ethanolamine Solutions

IN a previous communication from this laboratory,[1] it has been shown that the complex silver iodide bath gives electro-deposits of silver comparable to those from the silver cyanide bath. The present investigation deals with a similar attempt to obtain a suitable substitute for the commercial cyanide bath for the electro-deposition of copper, in view of its poisonous nature and instability.

Copper has been electro-deposited on steel from baths containing copper salt-ethanolamine complexes: (1) Copper oxalate-monœthanolamine, (2) copper oxalate-diethanolamine, and (3) copper oxalate, nitrate, citrate, tartrate, carbonate-triethanolamine. These baths are simpler than those attempted before.[2,3,4,5] As in the cyanide bath, immersion deposition is prevented by complex formation which reduces the effective copper (cupric) ion concentration. The latter has been determined by the E.M.F. method and is found to be of the order 1×10^{-33} to 10^{-35}N. A detailed study has been made of the effect of variation in (*a*) concentration of copper, (*b*) concentration of ethanolamine and (*c*) c.d., on the electro-deposition. The bath is comparable to the cyanide bath in respect of cathode efficiency, c.d. range, rate of deposition and brightness, adherence and general quality of the deposit. The cathode efficiency is nearly 100 per cent., except in the copper nitrate-triethanolamine bath, which gives lower values.

Rochelle salt, as a constituent of the copper oxalate-monœthanolamine bath, improves anode corrosion, increases the c.d. range, conductivity, cathode polarisation and throwing power, and yields better quality deposits by eliminating treeing and increasing the brightness. The optimum conditions for the various baths are given in the following table:

TABLE I

Bath Voltage 1·2 to 5·5 Volts

Copper salt (g./L)	Ethanolamine (c.c./L)	pH	Temperature °C.	Bright c.d. range (amp./dm²)
(*a*) Oxalate 60 + Rochelle salt 60 g./L	(mono-)60	9·5	24	2·4 –4·8
(*b*) Oxalate 45 + Rochelle salt 45 g./L	(di-) 68	9·0	24	1·2 –1·6
(*c*) „ 60	(tri-) 150	8·1	24	0·68–2·0
(*d*) Nitrate 45	(tri-) 135	8·3	24	0·64–1·6
(–) Nitrate 45	(tri-) 135	8·3	40	1·2 –3·6
(*e*) Citrate 30	(tri-) 150	9·3	24	0 4 –1·12
(*f*) Tartrate 45	(tri-) 135	8·6	24	0·24–0·8
(*g*) Carbonate 45 + Ammonia (24%) 50 c.c./L	(tri-) 135	9·5	24	1·2 –2·0

Higher temperatures are not conducive to proper working, except in the copper nitrate-triethanolamine bath. The effect of addition agents has been studied. A substantial improvement in the performance of the bath and the quality of the deposit has been noticed with some addition agents. The pH, conductivity and cathode polarisation have been measured. The throwing power, as calculated from c.d.-cathode potential curves is not as good as that of the cyanide bath.

The copper salt-ethanolamine baths have some important advantages over the cyanide bath, in respect of higher cathode efficiency, ability for good working at room temperature, brightness of deposits and improved performance with certain addition agents. In some

cases, a higher current density range has been found to operate. These baths, therefore, appear to be promising substitutes for the cyanide bath used in the electro-plating industry.

Our thanks are due to Prof. B. Sanjiva Rao, Head of the General Chemistry Section, for giving all facilities and taking interest in the work.

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N^4-(BIGUANIDYL-SUBSTITUTED)-N^1-BENZOYL SULPHANILAMIDES

CONSIDERING the interesting results in malarial chemotherapy, which have been noticed by Bami, Iyer and Guha[1] working in the field of N^4-substituted sulpha-biguanides, it was thought worthwhile to extend this field to include the highly active N^1-sulphanilyl-benzamide in view of the observation made by Sen Gupta,[2] *et al.* and Bose and Ghosh[3] that N^1-benzoylsulphanilamide possesses high antibacterial activity against certain strepto- and staphylo-infections *in vitro*, besides possessing high chemotherapeutic activity against Flexner organism and a very low toxicity. Bami, *et al.* have reported that some of the sulpha-biguanides possess suppressive antimalarial activity "when tested at relatively large doses" though not coming upto the standard of either paludrine or quinine.[4]

It was, therefore, considered desirable to study the influence of a substituted biguanide molecule attached to the N^4-position of N^1-benzoyl-sulphanilamide.

Some N^4-substituted biguanidyl-N^1-benzoyl-sulphanilamides of type (I) have now been synthesised for studying their effect against malarial and certain coccal infections.

$RNH-C(=NH)-NH-C(=NH)-NH-C_6H_4-SO_2NHCO.C_6H_5$ (where R=H —, substituted aryl—etc.)

Type I

The compounds have been prepared by refluxing N^1-sulphanilyl-benzamide hydrochloride with the appropriate cyanoguanidines in pyridine medium (ethanol unsuccessful) for 3-8 hours. All the sulpha-biguanides have been isolated and characterised as white powdery hydrochlorides, some being crystallisable from organic solvents; others being uncrystallisable could only be purified by removing the starting materials with suitable solvents. The compounds are amphoteric in nature. All the sulpha-biguanides (*vide* Table) excepting compound No. 4, get decomposed while melting.

No.	R in compounds Type I	M.P., °C.
1	H-	240–41
2	C_6H_5-	264
3	*p*-Cl-C_6H_4-	215–16
4	*m*-Cl-C_6H_4-	239
5	*p*-Br-C_6H_4-	266–68
6	*p*-I-C_6H_4-	230–32
7	*p*-CH_3O-C_6H_4-	213–14
8	*p*-CH_3-C_6H_4-	225–26

Full details will be published elsewhere.

We are indebted to the Indian Council of Medical Research for the award of a Fellowship to one of us (P. R. Gupta) and also to Messrs. Bengal Immunity Co., Ltd., Calcutta, for the gift of sulphanilyl benzamide.

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THE NUCLEAR OXIDATION OF COUMARINS

IN the course of the investigation requiring intermediates for the fluorescent azo dyes, we undertook the systematic oxidation of certain coumarin derivatives by the alkaline potassium persulphate method of Elbs.[1] This method has been used by Bargellini and Monti[2] to oxidise two coumarins, and by Seshadri and co-workers[3] to oxidise the flavones. As the hydroxy-coumarins failed to give any definite crystalline products, we have used their methyl ethers in pyridine solution and obtained definite results with the following coumarin derivatives.

(1) Coumarin, (2) 7-methoxy-4-methyl-coumarin, (3) 5-methoxy-4 : 7-dimethylcoumarin, (4) 5 : 7-dimethoxy-4-methylcoumarin, (5) 6 : 7-dimethoxy-4-methylcoumarin, (6)

7 : 8-dimethoxy-4-methylcoumarin, (7) 6-methoxy-4-methylcoumarin and (8) 4-methyl-1 : 2-α-naphtha-pyrone. All of them underwent oxidation with the insertion of the hydroxyl group in 6-position. Where this position was occupied, either the oxidation did not proceed or some abnormal reaction took place. These methoxy-hydroxy-coumarins could be demethylated smoothly with the formation of the unknown 5 : 6-dihydroxy-4-methylcoumarin, 5 : 6 : 7-trihydroxy-4-methylcoumarin, and 6 : 7 : 8-trihydroxy-4-methylcoumarin. We have applied this method for the synthesis of the natural coumarins scopoletin, fraxinol and fraxetin. Fuller details will be shortly published elsewhere.

Dept. of Chemical Technology, Matunga, Bombay 19, *September* 11, 1950.

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ADSORPTION OF HYDROGEN AT ELEVATED PRESSURES ON A PROMOTED IRON SYNTHETIC AMMONIA CATALYST

A static volumetric method, an improvement on that employed by Frolich and White,[1] has been developed for the measurement of adsorption of gases by solids at elevated pressures. Employing this method, the adsorption of hydrogen has been studied on a Fe — K_2O — Al_2O_3 — TiO_2 catalyst at seven temperatures ranging from 50° to 350° C. and at pressures from 15 to 50 atmospheres.

The results obtained indicate two distinct types of activated adsorpton of hydrogen in the temperature range studied, one showing a maximum at about 150° and the other at about 300° C. Emmett and Harkness[2] have found two types of activated adsorption of hydrogen on a doubly promoted iron catalyst, Type A occurring fairly rapidly between —78° and 0° C. and Type B at 100° C. Presuming that, in conformity with this observation, the present catalyst can also give rise to Type A adsorption and that the maximum found at 150° C. corresponds to the Type B chemisorption, the maximum at 300° C. noted in the present investigation therefore points to the occurrence of a third type of activated adsorption which may be designated as Type C. The occurrence of three different types of activated adsorption of hydrogen on iron can be explained on the basis of the 3-fold disposition of the iron atoms in the (111) crystallographic plane of the body centred cubic lattice of α-iron (Fig. 1 of Ref. 3).

The surface area of the catalyst as found by applying the B.E.T. equation[4] to the adsorption of argon on the reduced catalyst at liquid air temperature was 1·85 sq. m. (V_m = 0·48 cc.) per g. of unreduced catalyst. Assuming that in this determination the argon atoms were adsorbed only on the plane of the outermost iron atoms, while in the activated adsorption of hydrogen every iron atom of the surface, in any of the three possible dispositions, could chemisorb a hydrogen atom, an estimate could be made of the maximum adsorption of hydrogen on the part of the surface consisting of free iron atoms, which according to Brunauer and Emmett[3] cover roughly 40 per cent. of the total surface of a doubly promoted catalyst. The results show that beyond about 100° C., the adsorption exceeds the calculated surface saturation limit (0·4 cc./g.) at fairly high pressures. This indicates that especially at the higher pressures, there is marked absorption into the metal lattice. Further proof of the superposition of absorption on chemisorption is provided by the rather low values obtained for the heat of adsorption. For an adsorption of 0·2 cc./g. a value of 4,746 calories per mole is obtained for the heat of adsorption as against 8,500 calories per mole obtained by Emmett and Harkness.[2]

The authors are very thankful to Sir J. C. Ghosh for having given an inspiring lead to the present investigation and to Prof. B. Sanjiva Rao for his kind interest and encouragement.

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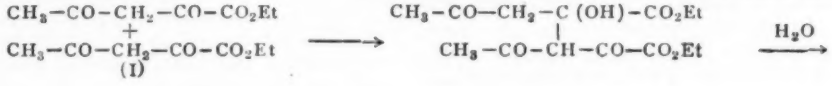
FORMATION AND NEW METHODS OF PREPARATION OF 3-ACETYL-4-CARBOXYLIC HEPTANOL-4-DIONE-2-3 CARBOXYLIC MONOETHYL ESTER-1

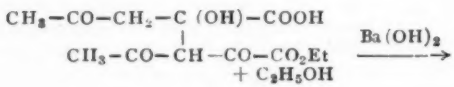
In the study of hydroxy and ethoxy methylene derivatives of substituted pyruvic ester, an attempt was made to prepare ethoxymethylene acetyl pyruvic ester (I) by Claisen's orthoformic ester and acetic anhydride method.[1] After removing acetic anhydride, the residual

oil, on distillation under reduced pressure gave unchanged acetyl pyruvic ester every time. In one such experiment the aqueous layer which was lying in a dish gave in 4-5 hours a good crop of crystals adhering to the gummy matter. They were separated mechanically on a porous tile and melted at 89-90°C. The analysis did not correspond to any of the expected reaction products of acetyl pyruvic ester and orthoformic ester. The melting point indicated it to be different from acetyl pyruvic ester (m.p. 10° C.). It was thought, therefore, to be a self-condensation product of acetyl pyruvic ester.

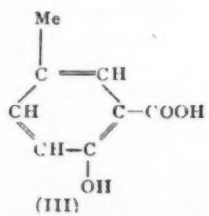
On reference to the literture, it was found that a compound, m.p. 91° C., was prepared by Claisen and Stylos[2] from acetyl pyruvic ester by a lengthy process. The sodium compound of (I) when shaken with glacial acetic acid and the crystallline precipitate thus obtained on treating with excess of dilute sulphuric acid gave (II), which with baryta water on water bath gave 5-oxy-3-methyl benzoic acid (III) [*cf.* Meldrum and Perkin.[3]]



(I)



(II)



(III)

In view of our observation, this lengthy process is not necessary. The compound (II) is formed in good quantity when distilled acetyl pyruvic ester is mixed with a little acetic acid and exposed to air in an open vessel or if undistilled acetyl pyruvic ester prepared according to Claisen,[4] containing traces of acid is simply exposed to atmosphere in contact with water. It behaves as a monobasic acid of the composition $C_{12}H_{16}O_8$ (*cf.* Claisen, *loc. cit.*) and proved identical with the compound prepared by Claisen's method by mixed melting point and the results of analysis. It is formed by a simple condensation of two molecules of acetyl pyruvic ester.

Since acetyl pyruvic ester self-condenses spontaneously in presence of acids, the Claisen's method (*loc. cit.*) for preparation of ethoxy or hydroxy methylene compound cannot be used. Also, since it forms its own sodium derivative with sodium ethoxide the Claisen's method,[5,6] using formic ester is not available. Weak bases (Knoevengal[7]) like the diethylamine, aniline, piperidine were tried as condensing agents in combination with formic ester. The first two gave the diethylamide and the anilide of the ester itself. With piperidine and formic ester however the self-condensation products of acetyl-pyruvic ester is again obtained in quantitative yield, extremely pure (*cf.* Kaushal).[8] Thus, formic ester does not combine with acidic or basic condensing agents with acetyl pyruvic ester on account of the great tendency of self-condensation of the latter.

Preparation of 3-acetyl-4-carboxylic heptanol-4-dione-2 : 6-carboxylic monoethyl ester-1 (II): *Method* 1.—Acetyl pyruvic ester 2g and 4-5 ml. acetic anhydride are heated together for 5 minutes and the mixture poured on watch glass, when in about half an hour crystals begin to separate. Recrystallised from acetone-water in long colourless needles, m.p. 90° C.

Method 2.—Acetyl pyruvic ester 5 g. and piperidine 4 ml. are mixed when much heat is evolved. The colour changes to deep red. The mixture is gently warmed and kept for 2-3 days. It is then acidified to neutralise piperidine, when in about 10 minutes crystals begin to separate. It is left in a dish for slow crystallisation when colourless shining needles are obtained, m.p. 92°C. In this case, the crystals are quite free from the adhering gum; the yield is 100 per cent. and the product was quite pure and it did not need any further purification. (According to experiment C = 50·5, H = 5·2 per cent. and E = 270, whereas $C_{12}H_{16}O_8$ requires C = 50·0, H = 5·6 per cent., and E = 288).

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ACCUMULATION OF CHOLESTEROL IN INOSITOL-DEFICIENT LARVAE OF *CORCYRA CEPHALONICA* St.

SLADE,[1] and Kirkwood and Phillips,[2] found that the growth of saccharomyces cerviseæ, was inhibited by the gamma isomer hexachlorocyclohexane (gammexane), due to its anti-inositol activity. Williams and Lane[3] have shown that inositol occurs in equimolecular proportions in purified α-amylase from pork pancreas and that gammexane inhibits amylolytic activity in a manner reversible by an excess of inositol. These findings, however, have been challenged by Fischer and Bernfeld,[4] who could not detect inositol in purified preparations of α-amylase from pig pancreas and from human saliva; nor could they find any inactivation by gamma hexachlorocyclohexane.

In the course of our studies on the enzymic role of inositol, it was found that gammexane retards the growth of rice moth larvæ (*Corcyra cephalonica* St.), and further, that this retardation was counteracted by the addition of either inositol or phytin to the diet. Estimation of amylase activity in the acetone dried tissues of larvæ, grown in the various diets, did not show any striking differences in the larvæ fed on either gammexane singly or on a mixture of gammexane and inositol in comparison with the controls. However, a marked accumulation of cholesterol was observed in the tissues of inositol deficient rice moth larvæ, while no such increase was observed when inositol or phytin was added to the gammexane diet.

The technique of rearing and employing the larvæ as the test organism is essentially the same as described earlier.[5] Ten-day old larvæ, fed on wheat bran, were placed in petri dishes containing adequate amounts of the following diets. The basal diet consisted of a mixture of wheat flour (2 parts) and tapioca (1 part) granulated and dried at 50° C. Gammexane, a 90% pure gamma isomer of hexachlorocyclohexane, dissolved in benzene was mixed with the basal diet at different levels in order to find the optimum concentration for inhibition of larval growth. It has been found that a concentration of 2 mgm. per cent. of gammexane in the diet retards larval growth and that this inhibition is counteracted by the addition of either 500 mgm. of phytin (calcium salt), or 100 mgm. of inositol in 100 grams of the basal diet. Typical data is given below for larval growth in milligrams for ten larvæ:—

TABLE I

Days	Weight of 10 larva expressed in milligrams 0	7	15	25	32
A. Basal diet + 2mgm. of gammexane in 100 gm. of diet ..	14·9	25·0	52·5	60·8	84·0
B. Same as A + 100 mgm. of inositol in 100 gm. of diet		Transferred	52·5	90·6	167·0
C. Basal diet ..	13·9	38·0	107·3	200·2	267·0

Amylase activity of acetone dried larval tissue was estimated by the method of Somogyi[6]; its cholesterol content was determined by the micro method of Schoenheimer and Sperry described in Hawk, Oser and Summerson,[7] using the Lumetron photoelectric colorimeter. The results were given in Table II.

TABLE II

Cholesterol content and amylase activity of larval tissue

	No. of larvæ used	Wt. for 10 larvæ mgm.	Amylase activity ml. of N/200 $Na_2S_2O_3$ per mgm. of enzyme powder	Cholesterol cont. mgm./100 gm. of larval tissue
A. Basal diet ..	10	281·6	5·03	102·4
	15	245·0	5·09	93·6
B. Diet A + 2 mgm./per cent. of gammaxane	75	58·0	4·83	216·4
	50	47·5	5·00	245·0
C. Diet B + 500 mgm./per cent. of phytin	25	210·3	4·85	80·6
	15	185·8	4·77	116·0
D. Diet B + 100 mgm./per cent. of inositol	30	182·9	4·90	121·5

The data show, (1) there is little difference in the amylase activity of tissues of larvæ raised on different diets; (2) there is a marked accumulation of cholesterol in the larvæ fed on "gammexane diet"; (3) the cholesterol content of larvæ fed on phytin or inositol diet is of the same order as that normally present in larvae raised on the basal diet. Cholesterol accumulation has not so far been reported in any organism in inositol deficiency, though Herrmann[8] reports that in aged hens, tissue cholesterol is demobilized on feeding them with inositol.

Further investigations are in progress. Thanks are due to Dr. W. H. Tisdale of E.I. Du Pont De

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A STUDY ON THE METHODS OF ISOLATION AND CULTURE OF MYCO TUBERCULOSIS

CULTURAL tests prove unsatisfactory when sputa are concentrated with sodium hydroxide, antiformin and sulphuric acid. Not only are these digestants slightly toxic[1,2] to the tubercle bacilli but they are not very effective decontaminants.

In our study of the isolation of tubercle bacilli from sputa prior to testing the tuberculostatic activity of antibiotics and other compounds we have tried various techniques of concentration to evaluate the best method for cultural purposes.

Toxicities of the commonly used digestants and those of trisodium phosphate[3] and sulphonated castor oil (Turkey red oil) were investigated. The latter was used in the hope that the small clumps of bacilli might get dispersed and give a uniform luxuriant growth. The experiments were conducted firstly against a pure growth of tubercle bacilli and secondly against the tubercle bacilli in a homogenised sputum as the sputa might exert a slight protective effect on the bacilli.

The following tables give in brief the digestant used, the exposure time allowed, and the amount of growth in each tube. The tests were done in triplicate and the average assessed.

The above experiments indicate that Turkey red oil inhibits the growth of all types of organisms. Sulphuric acid is a powerful disinfectant but also slows or prevents the growth of tubercle bacilli after 24 hours contact. Trisodium phosphate proves the best of all, and is able to initiate the growth even after 3 days exposure,

TABLE I

Growth of Tubercle bacilli on petrik's media inoculated with 10^{-3} mg. of aqueous suspensions of Tubercle bacilli exposed to various digestants

Exposure time	Digestants (final concentration)				
	NaOH 2%	H_2SO_4 3%	Antiformin 25%	Prisodium phosphate 5%	Turkey red oil 1%
Control	+++	+++	+++	+++	+
½ hour	+++	++	+++	+++	0
2 hours	+	+	++	++	0
24 hours	+	0	+	++	0
48 hours	0	0	0	+	0

Control: Medium inoculated immediately after mixing bacillary suspension and neutralised digestant. +++ = Heavy growth, ++ = Medium growth, + = Slight growth, 0 = No growth.

TABLE II

Growth of Tubercle bacilli on petrik's media inoculated with homogenised sputum containing Tubercle bacilli exposed to various digestants

Exposure time	Digestants (final concentration)				
	NaOH 2%	H_2SO_4 3%	Antiformin 25%	Trisodium posphate 25 %	Turkey red oil 1 %
15 mins.	Cont.	Cont.	Cont.	Cont.	0
30 ,,	+++	+++	+++	+++	0
2 hrs.	+++	++	++	+++	0
24 ,,	+	+	+	++	0
48 ,,	+	0	+	+	0
72 ,,	0	0	0	+	0

Cont - Contaminated.

Fuller details of the experiment will be published elsewhere.

My thanks are due to Dr. N. N. De and Dr. K. P. Menon for their valuable suggestions.

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ANTIBACTERIAL PROPERTIES OF SOME QUINOLINE SUBSTITUTED GUANIDES WITH SPECIAL REFERENCE TO THE ACUTE TOXICITY AND THE BACTERIOSTATIC ACTIVITY OF N'-(*p*-CHLOROPHENYL)-N^5-(8' CHLORO-5' QUINOLYL) BIGUANIDE ACETATE

QUINOLINE compounds are known to be strong antiseptics (Donath, 1881). Various di-oxyquinoline compounds have been investigated by Mancini (1932). Quinoline derivatives exert bacteriostatic action and some of iodated derivatives are effective amœbicides.[1] Sulphanamide[2] and acridine[3] substituted biguanides have been shown to possess bacteriostatic effect against some gram positive organisms.

In the course of work on quinoline substituted biguanides as possible antimalarials a number of N'-(8'chloro-5'quinolyl)-N^5-substituted biguanides had been synthesised.[4,5] The antimalarial properties of these compounds have been studied.* The present paper describes the antibacterial activity of some of the compounds. Limiting concentrations which just inhibit the growth of the organisms *in vitro* are given in Table I.

Compound No. 133 exhibits very high antibacterial activity as compared with other compounds. Further detailed investigations of this compound were undertaken.

The common gram positive pyogenic cocci, and gram negative bacilli of enteric and dysenteric group of organisms, all obtained from the Central Research Institute, Kasauli, were employed.

Serial dilutions of the drug were prepared in the medium which were later inoculated with 0·1 c.c. of a 18-hour broth culture. Culture controls and drug controls were included in each assay. After incubation for 48 hours,

TABLE I

Compound No.	Name	Minimum bacteriostatic concentration (48 hrs. incubation at 37° C.)			
		Staphylo	Strepto (pyogenes)	Bact. Coli.	Bact. Typhosum
133	N'-(*p*-chlorophenyl)-N^5-(8'-Chloro-5'-quinolyl) biguanide acetate	1 : 50,000	1 : 50,000	1 : 25,000	1 : 50,000
134	N'-(*p*-methoxyphenyl)-N^5-(8'-chloro 5' quinolyl) biguanide acetate	1 : 1,000	1 : 1,000	1 : 1,000	<1 : 1,000
136	N'-(8' chloro 5'-quinolyl)-N^5-isopropyl guanidine acetate	<1 : 1,000	1 : 1,000	<1 : 1,000	1 : 1,000

* These Compounds were synthesised by Prof. P. C. Guha and P. R. Guptta in the organic chemistry laboratories of the Indian Institute of Science, Bangalore 3.

TABLE II

Antibacterial spectrum of compound No. 133

Micro organism	Control	Dilutions					
		1 : 5,000	1 : 10,000	1 : 20,000	1 : 30,000	1 : 50,000	1 : 100,000
Staphylo aureus	++	−	−	−	−	−	+
Strepto pyogenes	++	−	−	−	−	−	+
Bact. typhosum	++	−	−	−	−	−	+
Sal. para typhosum A	++	−	−	−	−	−	±
Bact. flexnevi	++	−	−	−	−	−	±
Bact. shiga	++	−	−	−	−	±	+
Bact. Coli	++	−	−	−	+	+	+

Legend: ++ Heavy growth ; + Moderate growth ; ± Faint growth ; − No growth.

TABLE III

Acute toxicity of compound No. 133 for Mice

Dose mg.	Route administration	Number of mice	Average weight of mice (g.)	Death of mice (days)							Mortality %
				1	2	3	4	5	6	7	
8	I.v.	3	20	3	..	..	..	..	..	..	100
6	,,	2	20	2	..	..	..	..	..	..	100
4	,,	9	20	6	1	..	..	..	..	..	77
3·8	,,	4	20	2	..	..	..	..	..	..	50
3·6	,,	5	20	2	..	..	..	..	..	..	40
3·4	,,	3	20	0	..	..	..	..	..	..	0
3·2	,,	5	20	0	..	..	..	..	..	..	0

TABLE IV

Determination of LD_{50}

Dose mg./100 g.	Observed mortality	Deduced mortality	LD_{50}
30	2/2	..	..
20	7/9	11/13	..
19	2/4	4/8	19 mgm./100 g. body weight
18	2/5	2/9	..
17	0/3	..	..

the concentration of bacterial cell in each culture was turbidometrically determined. Results of observation are given in Table II.

The acute toxicity of the drug for the mice was determined. Graded doses of the drug in physiological saline were administered intravenously to young white mice. LD_{50} dose of the drug for this experimental animal was determined by Behren's method.[6] Tables III and IV present the experimental details.

Analysis of the above data shows that the maximum tolerated dose of the compound is 17 mg./100 gms. body weight and the minimal lethal dose is 19 mg./100 gms. body weight.

Unless precise information is available as to the influence of the drug on great many biological and biochemical processes, it is difficult to discuss the effects observed in living animals. Examination of the toxic data for mice, however, reveals that the maximum tolerated dose of the compound compares favourably with that of the other drugs at present employed in the chemotherapy of various intestinal infections. The low toxicity and the high chemotherapeutic index of the compound indicates the possibility of its chemotherapeutic employment.

Our thanks are due to Prof. P. C. Guha and P. R. Gupta for kindly supplying the compounds and to Dr. K. P. Menon for the helpful suggestions during the course of the investigation.

Pharmacology Laboratory, Ind. Inst. of Science, Bangalore-3, *September* 7, 1950.

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CHALKONES FROM QUINACETOPHENONE MONOMETHYL ETHER

KOSTANECKI and co-workers[1] condensed monomethyl- or ethyl-ether of quinacetophenone with methoxy or ethoxy-aldehydes in presence of alkali and obtained flavanones instead of the expected o-hydroxy chalkones, the ring formation having taken place under the experimental conditions. Since then it has been taken for granted that mono-methyl ether of quinacetophenone yields flavanones: while its isomer, resacetophenone methyl or ethyl ether[2] does give chalkones.

We have now exhaustively investigated the chalkone formation from quinacetophenone

mono-methyl ether. Repeating Kostanecki's experiments but without heating, we have been successful in isolating the chalkone from the reaction mixture after the removal of the flavanone. We have thus been successful in getting chalkones from anisaldehyde, veratraldehyde and *o*-methoxy-benzaldehyde. A method has been worked out for the separation of the above chalkone-flavanone mixture.

The chalkones obtained are orange to red coloured substances responding to Wilson's boric acid colour test[3] as well as to magnesium and hydrochloric acid test.[4]

The details of these experiments will be published elsewhere.

The work on the chalkone formation from mono-ethyl ether of quinacetophenone is in progress.

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Gujarat College, N. M. Shah.
Ahmedabad,
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A NOTE ON THE INFLUENCE OF BORON ON THE YIELD AND ASCORBIC ACID CONTENT IN THE TOMATO FRUIT

The indispensability of boron for more and better yield in plants has been proved by a number of workers.[1-4] But, little effort has been made to show precisely to what extent the element influences the yield and quality in higher concentrations.

It is evident by analyses (Table) that boron increases the yield of tomato fruit considerably in number and weight, with increasing doses of the element. The plants in complete absence of the element are severely set back in the size and yield of fruit as a large number of flower buds die before they could fully develop resulting in low yield.

It is clear from the table that ascorbic acid content gradually increased from green to yellow and red with increasing concentrations of the element, in general. However, the content of vitamin C was greater in fully ripened fruits in all cases, and the maximum in 3·0 p.p.m. A number of workers[1-4] have reported an increase in vitamin C in tomato grown in presence of boron than in absence of it. Although, it is clear from this investigation that ascorbic acid content, in general increased with increasing concentrations of boron, it cannot definitely be concluded to what extent the element influences the vitamin C content in tomato fruits as the vitamin C content is not merely influenced by the element, but also by the environmental conditions and the time of picking the fruit.

Influence of boron on the yield and vitamin C content in the tomato fruit

Treatments	Yield of fruits		Vitamin C content (in mgm. E.Q. per 100 c.c. of the juice) in different stages of the fruit		
	No. of fruits	Wt. in pounds	Green	Yellow	Red (Ripe)
No Boron	61	5·54	13·80	15·35	19·10
Boron 0·5 p.p.m.	95	8·68	17·70	19·04	20·30
,, 1·0 ,,	118	12·40	16·30	14·82	23·40
,, 2·0 ,,	123	15·27	21·00	27·25	33·60
,, 3·0 ,,	137	15·91	24·40	23·67	37·80

I am thankful to Prof. K. Kumar for his kind help during the course of this work.

Plant Physiological Lab., P. R. Govindan.
College of Agriculture,
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September, 6, 1950.

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ANATOMICAL CHANGES IN THE EMBRYO OF MUSTARD DURING VERNALISATION

Anatomical changes in relation to flowering in both normal and plants subjected to photoperiodic treatment have been thoroughly investigated by a number of workers,[1,2] but, as far as the author is aware, there is hardly any observation on plants induced to flower early through low temperature treatment. There exists a fundamental difference between the two, as the photoperiodic induction takes place in plants with well developed foliar leaves while in vernalisation the changes are confined to the embryo[3,4] where hardly any differentiation has taken place. This makes it necessary to follow the histological changes of the normal and chilled embryos and the subsequent behaviour of the seedlings and plants raised from them. In order to collect data on the same,

a series of investigations have been undertaken by the author on the various crops that have given vernalisation response under Indian conditions, and the present communication summarises the results obtained on the comparative vascular differentiation of the embryos of yellow *sarson*, T. 102, vernalised according to the technique of Sen and Chakravarti.[9]

In order to avoid error due to the difference in the size of the embryos to be compared, only unsplit seeds and split seeds with radicles just emerging out of the seed coat are selected. These are fixed in F.A.A., embedded in paraffin and sectioned serially at 13 μ and stained in iron-alum hæmatoxylin and safranin.

In the following table are given the vascu-

Treatment	Earliness in days	Vascular counts							
		Embryos I		II		III		IV	
		Cot. I	Cot. II	Cot. I	Cot. II	Cot. I	Cot. II	Cot. I	Cot. II
Soaked for 6 hours ..	..	No Vascular differentiation							
Unsplit seeds chilled for 6 days ..	5·67	*2 ; 0	2 ; 0	0 ; 0	0 ; 0	2 ; 0	? ; ?	1 ; 0	0 ; 0
Unsplit seeds chilled for 21 days ..	33·73	? ; 7	? ; 6	4 ; 7	3 ; 6	3 ; 7	5 ; 8	..	..
Just splitting untreated seeds ..	..	2 ; 0	? ; ?	3 ; 0	4 ; 0	5 ; 0	? ; ?	4 ; 2	? ; 0
Just splitting seeds chilled for 21 days ..	39·29	4 ; 11	3 ; 10	6 ; 8	4 ; ?	5 ; 9	? ; ?	..	..

* The first figure in each column indicates the number of mature phloem elements and the second that of xylem.

? Counts not possible due to obliqueness of the section.

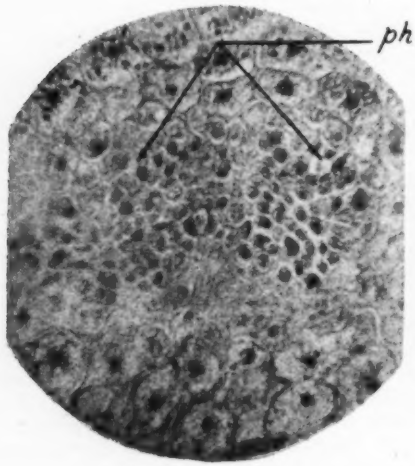

FIG. 1

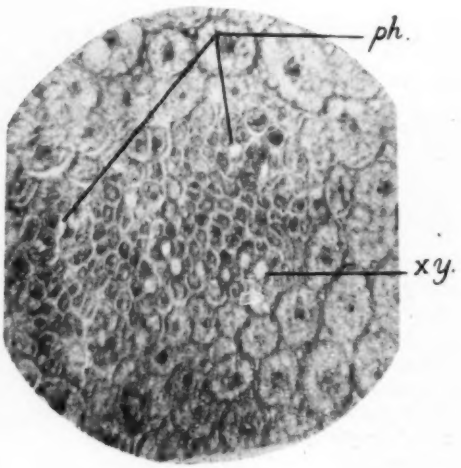

FIG. 2

FIG. 1. Transverse section of mid-vein of seedling III, Cot. I, of just splitting untreated seeds. Ph. Phloem elements. (× 440).

FIG. 2. Transverse section of mid-vein of seedling III, Cot. I, of just splitting seeds chilled for 21 days, Xy. Xylem elements (×440).

lar counts in the mid-vein of the cotyledonary petiole near the stem-tip of three to four seedlings out of nearly a dozen examined per treatment. As the embryo of mustard is very much curved, counts in all the seedlings at the same height are not possible. The vernalisation response recorded is from October 12, 1949 sowing.

From the above table and Figs. 1 and 2, it would be clear that in the cotyledonary traces of mustard, the differentiation of xylem elements is preceded by that of the phloem, and the former is much more rapid in the treated than in the corresponding untreated. The cotyledonary petiole of the split seeds chilled for 21 days have as many as 8 to 11 xylary elements fully differentiated, while there is none in three and only 2 in one of the four corresponding untreated embryos. The number of xylary elements in unsplit seeds with 5·56 days longer vegetative cycle varied from 6 to 8, indicating thereby a positive correlation between their number and degree of vernalisation.

This differentiation in the untreated seeds is not only confined to the cotyledonary petiole but extends throughout the entire length from the tip of the radicle to the cotyledons. In the cotyledons of just sprouting untreated seeds, all the veins are in the procambium stage, while majority of those in the corresponding treated ones have xylem and phloem elements differentiated, the number of which varies according to the position of the veins.

Bassarskaja,[5] working on rye, reports that there exists no structural difference between the treated and untreated seeds. This indicates that mustard differs from the cereal crops not only as regards its requirements during chilling[4,6] and germination[7] of the excised embryos, the behaviour on storage of the vernalised seeds,[8,9] and non-obligatory low temperature requirement for the thermophase,[9] but also as regards anatomical changes during the process of chilling.

The significance of this early vascular differentiation in vernalised seeds is not clear. The problem of transport which is practically nil at such an early stage, is identical in both the treated and the untreated seeds. However, it is definite that on sowing, the treated seedlings get an advantage over the untreated ones in having an elaborate transporting system which might help them in completing the vegetative cycle early.

My thanks are due to Dr. Bahadur Singh for his kind help during the preparation of this note.

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Agra,
July 2, 1950.

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A SIMPLE SAND CULTURE EQUIPMENT FOR GROWING RICE PLANTS

Two methods are described for growing rice plants in sand substratum—the drip method and the flush method.

In the drip method (Fig. 1) a glazed porcelain pot (A) of height 27 cm. and internal dia-

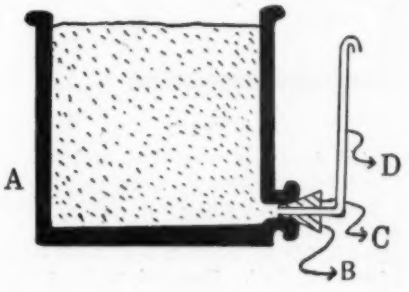

FIG. 1

meter 25 cm. with a drain hole on the side (B) was used as a culture jar and fitted with a one holed stopper (C) containing a bent glass tube (D). The pot contains coarse river sand, which had been first washed with 5 per cent. solution of HCl and subsequently with 5 per cent. solution of ammonium hydroxide and water.[1] Rice seedlings (D.I. 4 seeds, supplied by the Bidydharpur Government Farm) of 8-9 cm. height were transplanted to the sand substratum of the pot. The required nutrient solution was stored in a reservoir which was kept on a raised support. The solution was allowed to drip over the surface of the sand through glass pipes. The excess of the nutrient solu-

tion from the pot flowed away from the bent glass tube (Fig. 1 D). Thus, a continuous flow of the nutrient solution was maintained.

In the flush method (used in the micro-nutritional study of the effect of boron on the growth and development of the rice plant) the same glazed pots were used. The arrangement of apparatus is illustrated in Fig. 2. Inside the glazed pot (A) a layer of stonegravel (S') (collected from the river bed and washed in HCl and subsequently in ammonia and water) was covered with washed sand (S"). The drain hole (B) of the pot was fitted with a one-holed cork (C) to which a bent glass tube (D) had been attached. One end of the glass tube (inside the pot) was plugged with glasswool to check the displacement of sand particles and to the other end, a rubber tubing with a pinch cock (P_1), which regulated the discharge of the culture solution, was fitted up. The pot was kept on a cement bench (X) and a large flask (F) was kept just below the tube to collect the discharged solution. The solution was allowed to drain out from the pot every evening and the collected solution was replaced the next morning. Each week the solution was discarded (twice or thrice) and fresh solution was added.

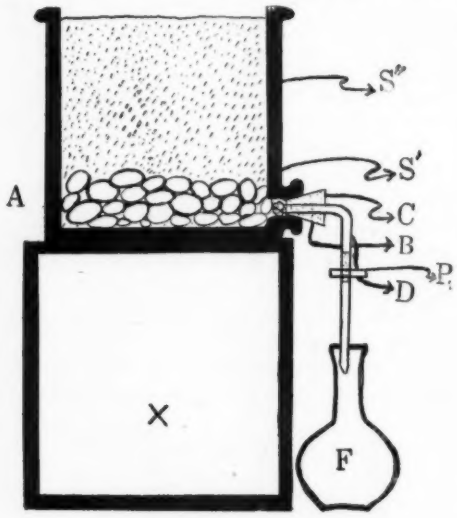

FIG. 2

It was observed that in the case of pots where the solution was supplied continuously, there were thick crust formation on the surface of the sand, whereas no such crust formation was noticed in pots where the solution was changed twice weekly. The crust formation was due to too much damping of the surface of the sand. It was also noted that the leaves of plants fed continuously with the culture solution were slightly pale looking but where the solution was changed biweekly, the plants were normal and healthy. The flush method also avoids the construction of a raised platform needed for the drip method. Pumping sets which have been used for sand culture work by a number of workers were also not required. The crust formation was avoided and lastly in this method, the used solution can easily be taken for analysis.

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Botany Laboratory, SHYAMANANDA PATTANAIK.
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STAINING BACTERIAL FLAGELLA

STAINING flagella is a rather difficult process. Different methods have been suggested from time to time, but no one method has been universally accepted because of lack of uniformally good results. In actual practice, the bacteriologists try many methods, but adopt one giving the best performance. Of the methods advocated by Gray,[1] Zettnow,[2] Van Ermengem,[2] Bailey,[1] Leifson,[1] Pitfield,[2] Loeffler,[2] and Cesares-Gil,[1] the last 3 have usually given us fairly good results. The following protocol has, however, given us surprisingly better results with several organisms.

(1) A loopful of 12-18 hr. old culture grown on potato dextrose agar slant is carefully placed in a drop of water on a clean slide gently touching and spreading it to 2 sq. cm. until faint turbidity is obtained. Dry in air.

(2) To cover the smear, add 4 drops of solution 'A' to be immediately followed by 4 drops of solution 'B'. Heat gently until fumes come out without boiling, the entire process taking 2 minutes.

(3) Add two drops of solution 'C' and heat the slide for 3 minutes until fumes come out without boiling. This important procedure of mordanting and staining should be followed carefully.

(4) Wash in a gentle stream of water.

(5) Flood the smear again with solution 'C' and heat gently for 1½ to 2 minutes or until fumes come out without boiling.

(6) Wash in a gentle flow of water, dry in air or over a flame and examine.

SOLUTION 'A'		SOLUTION 'B'	
Tannic acid	.. 2 gm.	Iodine crystals	.. 2 gm.
Dist. water	.. 100 ml.	1 N. NaOH	.. 10 ml.
Filter and store		Make it upto 100 ml. with water after iodine is dissolved.	

SOLUTION 'C'

(i)		(ii)	
Basic fuchsin	0·3 gm.	Phenol	.. 5 gm.
Ethyl alcohol (95%)	10 ml.	Dist. water	.. 95 ml.

Mix the two solutions.

Iodine and sodium hydroxide in solution 'B' used as a mordant in Gram stain stand out, probably due to their alkaline nature. Phenol in solution 'C' on the other hand, intensifies basic fuchsin, possibly due to its withdrawing water from the bacterial cells and forming metallic shiny precipitate. Of the methods referred to above, only those of Bailey, Fisher and Conn (Bailey's modification), Casares-Gil and Gray utilise Ziehl-Neelsen carbol fuchsin stain (authors' solution 'C'). Thus 'A' only forms an additional solution in the protocol, a very great advantage.

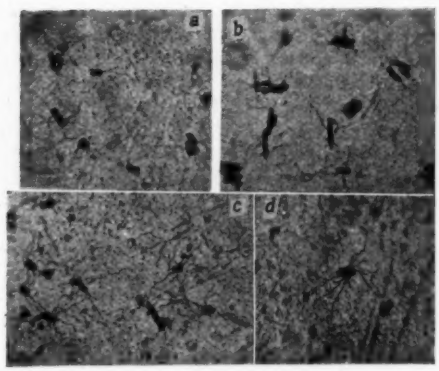

FIG. 1. Peritrichous flagella of, (*a*) *Bact. carotovorum*, (*b*) *B. subtilis*, (*c*) *Esch. Coli* and (*d*) *Rhizobium phaseoli* × 910.

The method advocated herein gives comparatively clean background, because of the finer and less conspicuous precipitates and lesser interference with the deep staining of bacterial cells and their flagella (Fig. 1) *Escherichia coli*, *Bacillus subtilis*, *Bacterium carotovorum*, *Xanthomonas malvacearum*, *Pseudomonas æruginosa*, *Ps. mangiferæ-indicæ* and two new spp. of plant pathogens, *Rhizobium phaseoli* and *Eberthella typhosa* have been successfully stained by this method.

College of Agriculture, M. K. PATEL.
Poona, N. B. KULKARNI.
April 24, 1950. S. R. GAEKWAD.

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MEIOSIS IN THREE GENERA OF INDIAN HETEROPTERA

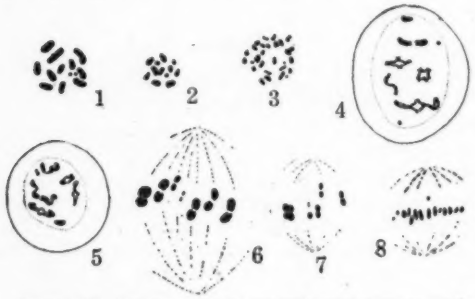
OUR knowledge of the chromosomes of Indian hemipterans is confined to a single paper by Misra[2] although much valuable work has been done on them in other countries (for reference see White[3] and Hughes-Schrader[1]). The present account deals with the meiosis of three species of Heteroptera belonging to as many genera and families.

Testes of adult males from the following material form the basis of the present study; (i) *Riptortus* sp., family Coreidæ, (ii) *Spherodema rusticum* (Fabr.), family Belostomatidæ; (iii) *Chrysocoris stolii* (Wollf.), family Pentatomidæ. The material was collected from the suburbs of Calcutta. The testes were dissected out from the specimens in the living condition and fixed in Belling's modification of Navashin's mixture. Sections were cut at 20 to 25 μ thickness and stained in iodine-crystal violet. The figures are reproduced at a magnification of 3,000 diameters.

The chromosome numbers determined from the spermatogonial metaphase stages are $2n = 13$, 12 and 28 in *Riptortus*, *Chrysocoris* and *Spherodema* respectively (Figs. 1-3). Both *Riptortus* and *Spherodema* have a pair of minute chromosomes which stand out distinct in the mitotic complement whereas the smallest pair in *Chrysocoris* is not so easily distinguishable. Wilson[4] termed the smallest pair of chromosomes in Coreidæ as *m*-chromosomes. Reasonably accurate measurements of the chromosomes could be made only in *Riptortus* and *Chrysocoris*. Their sizes vary between 2·03-1·14 μ in the former (except the m-chromosomes which are spherical having a diameter of ·33 μ) and between 1·03-0·55 μ in the latter.

In the resting stage of the primary spermatocytes a spherical heterochromatic body is seen

in all the three species. *Chrysocoris* and *Spherodema* have an XX-XY and *Riptortus* XX-XO mechanism of sex determination (*vide infra*). It is likely that one of the sex chromosomes, probably the X, shows positive heteropycnotic behaviour at this stage. It is, however, possible that the X and Y fuse together to form a single mass in those species which have XY sex-determining mechanism. At diplotene, the bivalents, as a rule, form only one chiasma per bivalent which in some is interstial and in others terminal. The chiasma frequency in *Riptortus* is one per bivalent



FIGS. 1-3. Spermatogonial metaphase chromosomes in *Riptortus* sp., *Chrysocoris stolii* and *Spherodema rusticum* respectively. FIGS 4 & 5. Late diplotene stages in *Riptortus*. FIG. 6. Metaphase I in *Riptortus*. FIGS. 7 & 8. Metaphase II in *Chrysocoris* and *Spherodema* respectively.

(Figs. 4 and 5) whereas it is slightly more than one in the other two species which indicates that only in a few cases there are two chiasmata per bivalent. The two members of the *m*-chromosome pair in *Riptortus* lie wide apart (Fig. 4) within the diplotene nuclei in 51 per cent. cases whereas in the rest they are closely apposed (Fig. 5) without forming any chiasma. The X chromosome in *Riptortus* is univalent and strongly heteropycnotic and the X and Y in the other two species are also heteropycnotic but lie distinct from each other. In diakinesis the *m*-chromosomes of *Riptortus* lie wide apart within the nuclei in 52 per cent. of cases.

In the first meiotic division, the sex chromosomes in all the three species divide but they segregate in the second division. It is to be noted, however, that the two *m*-chromosomes which were completely separate in about half of the diplotene and diakinesis nuclei in *Riptortus* are now invariably associated in pairs and pass regularly to the opposite poles of the spindle (Fig. 6). In the second division the X and Y in *Chrysocoris* and *Spherodema* form a pseudobivalent (Figs. 7 and 8) and pass to the opposite poles during anaphase separation. The single X chromosome in *Riptortus* passes towards one pole and can be easily identified because all the other chromosomes are bipartite, while it is single.

The author is indebted to Dr. S. P. Ray-Chaudhuri of the Calcutta University, for his help and guidance during the course of investigation and to Dr. A. P. Kapur of the Zoological Survey of India, for identification of the material.

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Zoology Department,
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A MODIFIED TREATMENT AGAINST LOOSE SMUT OF WHEAT

WHEAT occupies an area of over one and a half million acres in Bombay State (excluding the merged areas) and is fairly well distributed. Loose smut [*Ustilago tritici* (Pers.) Rostr.] occurs to the extent of 5 to 10 per cent., the damage varying from year to year. Taking the average loss at 5 per cent., the total annual loss works out to 14,285 tons of grain or Rs. 40,00,000.

Luthra and Sattar[1] modified Jensen's hot water treatment by taking advantage of high temperatures of 120° and 130° F. in the shade and sun respectively during June-August at Lyallpur. The modified treatment could not be used in Bombay since the temperature in the sun hardly exceeds 121° F. Table I shows the temperatures recorded at Viramgam, Broach, Jalgaon, Bijapur and Poona during the first fortnight of May, the hottest month of the year.

TABLE I

Stations	Maximum temperatures		
	In open		In shade Air
	Water	Air	
Viramgam ..	111	121	110-111
Broach ..	105	116	104-107
Jalgaon ..	109	120	109-110
Bijapur ..	107	110	101-103
Poona ..	104	106	101-102

It is seen that the temperatures at Viramgam, the hottest place in the Bombay State are

in every case lower by 9-10° F. than that at Lyallpur.

A modification of the solar energy method was devised at Broach during the first fortnight of May 1948, with successful results. It consisted of soaking the seed in water at room temperature from 8 a.m. to 12 noon, then spreading it in a thin layer on plain galvanised iron sheets in the sun for 1½ to 2 hours. Stirring the seed once or twice during this period keeps it in contact with the hot surface of the sheet. The temperature of seed collected in a heap at the end of the exposure was found to be 130-133° F. This had two advantages over the method of Vasudeva and Iyengar,[2] *viz.*, (1) brick-floor is not necessary, and (2) it can be employed in Peninsular India where temperatures are not as high as in Northern India.

The seed was dried thoroughly under shade, mixed with B.H.C. to avoid insect attack and stored. The treatment had no adverse effect on germination. The treated seed was dibbled in 4 replications at Pakhajan (Broach District), Jalgaon, Dharwar and Poona during two years (1948-49, 1949-50). The results are given below:—

TABLE II

Effect of solar heat exposure on the per cent. infection by loose smut

Treatment (Period of exposure on sheet)	Per cent. infection at			
	Broach*	Jalgaon*	Dharwar*	Poona†
1 hour	0·0	0·03	0·09	0·13
1½ hours	0·0	0·00	0·00	0·00
2 ,,	0·0	0·00	0·00	0·00
Control	6·2	4·7	3·6	4·1

* Based on the initial population of 3,000 plants and † 800 plants in each treatment.

The results indicate that exposing soaked seed on galvanised iron sheet to the sun for 1½ to 2 hours completely controls the disease.

Thanks are due to Shri. B. J. Thakar, Cotton Breeder, Broach, for providing facilities during these investigations.

Plant Path. Lab., Agricultural College, Poona,
August 3, 1950.

M. K. PATEL.
G. W. DHANDE.
Y. S. KULKARNI.

1. Luthra, J. C. and Sattar, A., *Ind. J. Agric. Sci.*, 1934, **4**, 177. 2. Vasudeva, R. S. and Iyengar, M. R. S., *Curr. Sci.*, 1950, **19**, 218.

A NOTE ON THE TERATOLOGY OF FLOWERS OF *ZEPHRANTHES ROSEUM* LINDL.

IN August 1948, the writer observed some teratological characters in the flowers of *Zephranthes roseum* Lindl., family Amaryllidaceæ, cultivated in the Botanical Garden, Khalsa College, Amritsar. However, in the flowers of the plants growing on the Mussoorie hills none of such abnormalities were observed.

The flowers showed a hexa-merous tendency, partial staminody of the petals and partial petalody of the stamens and an increase in the bifurcation of the stigmas into as many parts as the loculi in the ovary—from trilocular to hexalocular. An interesting feature noted in a flower was that an anther lobe had developed on one of the arms of the stigma. The anther lacked a filament, but possessed normal pollen grains (Fig. 1).

The development of an anther on the stigma has not been reported so far to the author's knowledge.

Botany Department, University, Gauhati,
July 23, 1950.

P. KACHROO.

CINTRACTIA MINOR ON THREE SPECIES OF *CYPERUS* IN MYSORE

COLLECTIONS of smuts were made on three species of *Cyperus* near Hebbal, Bangalore. On *Cyperus rotundus* L., *C. compressus* L., and *C. pangorei* Rottb., the infection occurred both on the peduncles and within the ovary. In the latter case, the hard seed was replaced by an agglutinated black spore mass. Comparative studies indicated that a single species was involved on all the three hosts, and the smut was identical with *Cintractia minor* (Clinton) Jackson,[1] which is already known to parasitise the ovaries and peduncles of *Cyperus* sp. The

sori were at first covered by the false membrane, which flakes away at maturity exposing the olive-black agglutinated spore mass. The spores were reddish-brown, subglobose to spherical, and measured 9 to 12·5 μ in diameter with a mean of 11 μ.

Review of literature indicated that *Cintractia minor* has been incorrectly cited in India as *C. peribebuyensis* (Speg.) Speg. including in a recent paper by Venkatarayan,[4] though Ling[2] by a study of the type material pointed out that *C. peribebuyensis* is synonymous with *C. axicola* (Berk.) Cornu. *C. minor* proposed by Jackson[1] by raising *C. axicola* var. *minor* Clinton. to specific rank is a separate smut species. For *C. minor* on *Cyperus Pangorei*, Venkatarayan[4] gives an expatiated account of the sori development, which, in general, conforms to the earlier descriptions given by McAlpine[3] and others for *Cintractia*.

Bangalore, K. M. SAFEEULLA.
August 25, 1950. H. C. GOVINDU.

1. Jackson, H. S., *Mycologia*, 1920, **12**, 153. 2. Ling Lee, *Revista Argent. de Agronomia*, 1948, **15**, 254–55. 3. McAlpine, D., *The Smuts of Australia*, 1910, p. 288. 4. Venkatarayan, S. V., *Curr. Sci.*, 1949, **18**, 13.

A CASE OF TWIN OVULES IN *ISOMERIS ARBOREA*

DURING the course of a reinvestigation of the embryology of *Isomeris arborea* (Capparidaceæ), undertaken at the suggestion of Dr. P. Maheshwari, a case of abnormal twinning of ovules has been observed.

The ovule of *Isomeris arborea* is campylotropous, bitegmic and crassinucellate. The micropyle is formed by both the integuments. The abnormal case of twin ovules consisted of two ovules borne on the same funicle and enclosed within a single, common outer integument, the nucellus of each ovule being surrounded by its own separate inner integument (Fig. 1). The ovules borne on the same funicle and enclosed As shown in the figure, one of the ovules was seen in longitudinal section, the other being cut transversely and showing a circular outline. This indicates that the two ovules were situated at right angles to each other.

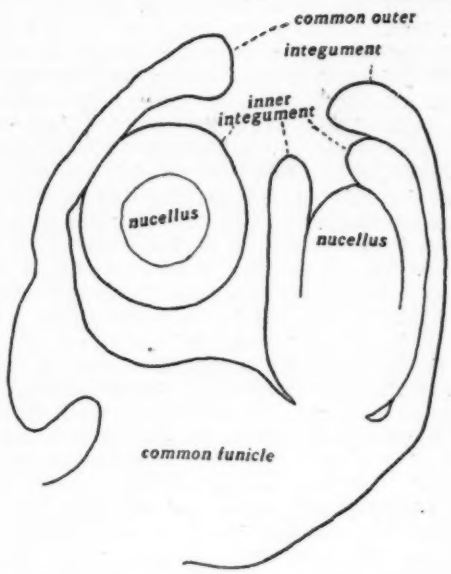

FIG. 1. *Isomeris arborea*. An outline drawing of the twin ovules. × 332.

A case somewhat similar to the one described here has been reported by Rao[1] (1938) in *Capparis galeata* in which "two completely separate nucelli are enclosed by the same integument". This case is also peculiar because it seems that there is only one integument here as shown by his figure as well. The two nucelli seem to be situated side by side in the same plane and not at right angles to each other as in the present case.

The material on which this note is based was collected by Prof. P. Maheshwari in California in 1947 and later passed on to me for reinvestigation. I gratefully acknowledge the help received from him in connection with this work.

Botany Department, REAYAT KHAN.
Aligarh Muslim University,
Aligarh, U.P.,
August 10, 1950.

1. Rao, V. S., "Studies on Capparidaceæ–III. Genus *Capparis*," *J. Indian Bot. Soc.*, 1938, **17**, 69–80.

REVIEWS

Fourier Methods. By Philip Franklin. (McGraw Hill Book Co., New York), 1949. Price $4·00.

This text-book is intended as an introduction to Fourier Series and Laplace Transformation and their application to the solution of some of the boundary value problems in Physics and Engineering. The aim of the author appears to be to impart to the student facility in the technique of applying Fourier Series and Laplace Transforms to actual boundary value problems. Thus we find that, while the formal processes of calculating the Fourier coefficients and the solution of particular boundary value problems is illustrated at some length by means of a variety of examples carefully worked out, the relevant theorems of convergence, etc., are only stated without proof. The problems treated are those of heat conduction, the vibrating string, the transmission line and the hollow rectangular wave-guide. The last chapter contains a short and lucid introduction to the method of the Laplace Transformation for the solution of boundary value problems, along with a brief table of Laplace Transforms. Each chapter contains a large collection of carefully chosen exercises, and references to sources of further information. The book may be heartily recommended to those who wish to acquire quickly some familiarity with these standard methods for the solution of boundary value problems.

V. R. T.

Progressive Mathematics. By P. Clyme, Responsible Lecturer in Engineering Department at Mid.-Essex Technical College, Chelmsford. (Chapman & Hall Ltd., London), 1950. Pp. 270. Price 15 *sh.* net.

This book is intended mainly for Higher National certificate candidates for Physics and Engineering, though, as the author writes in its preface, the volume does not purport to cover any particular syllabus. The topics covered include the usual portions of Algebra, Trigonometry, Analytical Geometry, Calculus with its applications to Geometry and Mechanics, Fourier's series and Harmonic Analysis. The book concludes with a chapter on Differential Equations and a few appendices.

The author adopts an entirely new approach to mathematical teaching, which departs from all traditional methods. One of the features of that approach is the introduction of occasional dialogues between student and teacher. But, in the opinion of the reviewer, the unconventionality of the exposition has been rather overdone. In introducing basic mathematical concepts like limit, the sum of an infinite series and so on, the author ought to have exercised some restraint even while catering to the 'difficult ones' amongst his students. His treatment of indeterminate quantities and infinite series does hardly any justice to 'progressive' mathematics! Some of his unconventional ways of expression may be quoted as samples: $\frac{1}{0} \to \infty$, "$\frac{0}{0}$ may be anything from 0 to ∞" (why not, if it comes to that, from $-\infty$ to $+\infty$?). "An infinite series is said to be convergent or divergent according as to whether its sum is finite or not" (whatever the word 'sum' means!). "If the terms of a series are alternately positive and negative and the numerical value of each term is less than that of the preceeding term, the series is convergent." And so on. The book abounds in such statements. From the standpoint of mathematical teaching, one wonders as to how far the book is of true service to the students for whom it is written.

T. S. N.

Mechanics *via* the Calculus. By P. W. Norris and W. Seymour Legge. Third Edition, enlarged. (Cleaver Hume Press, Ltd., London), 1950. Pp. xii + 367. Price 16 *sh.*

This is a new edition of a work which has been popular, particularly with students of engineering, and its issue shows that the demand for the book is continuing. It is distinguished especially by the large number of typical problems worked out in detail and equally by the numerous exercises, some 550 in number. The principles of the subject are enunciated with a view to provide the basis for the problems, rather than for their intrinsic interest. This edition is mainly a reprint of the first edition, even a misprint on p. 224 remaining uncorrected. But some problems have been added wherever there was space remaining in a page at the end of a chapter, while a new chapter on Vectors and Vector Algebra and two appendices—one on the Principal Axes of Inertia, and the other on the Instantaneous Centre of Rotation—have been added. The notation for a vector product is not the usual one of Gibbs—$\mathbf{a} \wedge \mathbf{b}$ instead of $\mathbf{a} \times \mathbf{b}$. Triple products

and differentiation of a vector with respect to a scalar are included, but not the operator ∇. The chapter gives a taste of vector methods which may lead the interested student to further study. We wish the book a continued life of service.

T. S. S.

Verstandliche Elemente der Wellenmechanik: I Teil, Photonen, freie Elektronen, einelektronige Atome (Intelligible elements of wavemechanics: Part I, Photons, free electrons and one electron atoms). By Karl Jellinek. (Wepf & Co., Verlag, Basel), 1950. Pp. 304. Price *Sw. Fr.* 34.

In spite of the fact that a number of textbooks and treatises are already available dealing with wave mechanics, the book under review is a welcome addition to the literature on the subject. It is essentially addressed to the experimental physicists and chemists, who are interested in the application of wave mechanical ideas in interpreting their results and who wish to familiarise themselves with the basic concepts of the new mechanics. In fact, the sub-title of the book is "Eine Einführung für experimentelle Naturwissenschaftler".

Prof. Jellinek is the well-known author of the five-volume *Lehrbuch der physikalischen Chemie*. In his *Lehrbuch*, many topics were discussed from the standpoint of wave mechanics, although no presentation was given of the fundamentals of the subject. The present volume is the outcome of Prof. Jellinek's attempt to fill up this deficiency. It is the first of two volumes, the second of which will deal with atoms having more than one electron and with di- and polyatomic molecules. The following list of chapter headings will give an idea of the scope of the present book: I. Wave mechanics and light, II. Wave mechanics and matter, III. Differential equations, IV. The partial differential equation of wave propagation, V. Standing waves, VI. The time-independent Schroedinger equation, VII. Particle in a cavity with impenetrable walls, VIII. The linear harmonic oscillator, IX. The spatial harmonic oscillator, X. The rigid rotator, XI. The hydrogen atom, XII. Potential barriers. Although it would appear from the above that the book is mainly mathematical, the emphasis is essentially on physical concepts rather than on mathematical formalism. In fact, only a knowledge of the calculus is expected on the part of the reader and any other mathematics that is required is developed in the course of the book itself.

The reviewer regrets that this book was not written in English although the author is residing at present in London, as is noted from the preface. However, the treatment is so lucid that persons even with a small acquaintance of the German language can profitably read through the book. It should find a place in every chemist's library.

G. N. RAMACHANDRAN.

Hyderabad Engineering Research Laboratories: Annual Report for 1949: Publication No 3. Pp. xxii + 260. Price Rs. 7-8-0.

The Report is divided into five parts, viz., Hydraulics, Soil mechanics, Engineering materials, Physics and Chemistry and Hydrometeorology.

In the Hydraulics Section, reports about the tests conducted in connection with the design of suitable irrigation structures for the various projects in the Hyderabad State are given. Reports about experiments conducted, (1) to devise suitable divide walls at the junctions of aprons to arrest parallel flow and to provide subsidiary weirs below the protective works to eliminate shooting flow; (2) to design high coefficient weir profiles for free and submerged flows and stilling basin type energy dissipators with staggered blocks; (3) to design a spur and protective works to deflect a high velocity jet, etc., are given. Tests of a similar nature have been conducted by other research laboratories in India and elsewhere, and it would be an advantage if the results are pooled together to eliminate repetition as far as possible, though each case has its own peculiarities.

In the Soil Mechanics Section, the results of mechanical analysis of soil samples used for the manufacture of soil cement bricks, as well as a description of classification tests on certain soils and tests conducted on rammed earth are given. Results of various tests conducted to test the suitability of a particular soil for earth dam construction are also given. However, no mention is made about tests conducted to determine the shear strength of the soil.

In the section on engineering materials, various experiments conducted on the properties and strength of materials such as: the suitability of sand for use in surki mortar, cement concrete, etc.; the suitability of lime surki mortar for the Tungabhadra dam: the properties of aggregates in concrete, cement concrete of lean proportions; the thermal characteristic of corrugated iron, asbestos cement roofs and their insulation with paddy husk, mix, etc., are given.

In the section on physics and chemistry, results of tests conducted for chemical examina-

tion of the suitability of soils for earth dams, rammed earth walls, soil stabilisation analysis of lime, limestone, cement, etc., are given.

In the Hydro-Meteorology Section, results of preliminary investigation on evaporation losses from free water surfaces and study of evaporation losses on temperature basis are given.

V. K.

Technique of Radio Design. By E. E. Zepler. Second Edition, revised. (Chapman & Hall, London), 1949. Pp. xv + 394. Price 25 *sh.* net.

This is the second edition of a book, which was reviewed in detail, in a previous issue of *Current Science*.* In this new edition, the book is very much improved and the author has taken pains to utilise the helpful suggestions made by critics. Such of the new material as was of practical importance has been added, but the general treatment remains the same. A welcome feature of the book is the chapter on receiver noise and the twenty-two pages devoted to it are most useful and well-balanced. In fact, it is an achievement on the part of the author to sift the vast volume of material now available and compress it in such a short space.

The book is larger in size by 94 pages and 23 new diagrams have been added. The printing and get-up continues to be good. This new edition can be most heartily recommended to students of communication engineering and to libraries.

S. V. CHANDRASHEKHAR AIYA.

* *Curr. Sci.*, 1943, **12**, p 260.

An Introduction to the Theory and Design of Electric Wave Filters. By F. Scowen. Second Edition, revised. (Published by Chapman & Hall, London), 1950. Pp. xi + 188. Price 18 *sh.* net.

This book written by a person actively engaged in the design of filters, is indispensable to every worker in the field. It is divided into twenty chapters dealing with the mathematics required, general electrical theory, theory of filters, detailed consideration of low pass, high pass, band pass and band suppression types, etc. This is followed by detailed treatment of filter design, including the practical aspects. The last chapter is on Darlington's insertion loss method of filter design. This is an addition in the new edition. The division of the material into different chapters is very apt and each chapter contains the major information wanted.

The printing and get-up of the book are quite good and free from serious errors or misprints.

The book can be heartily recommended to every person interested in this field including the research workers, who will find the very brief but well-selected bibliography quite helpful.

S. V. CHANDRASHEKHAR AIYA.

Elsevier's Encyclopaedia of Organic Chemistry. Edited by F. Radt. Series III. Carboisocyclic condensed compounds. Vol. 12-B. Naphthalene. A. Compounds containing one naphthalene nucleus. Hydroxy compounds. (Elsevier Publishing Co., Inc., New York & Cleaver Hume Press, Ltd., London W. 1.), 1950. Pp. 1053-2187. Price £29-0-0.

Elsevier's Encyclopædia, undertaken as an English analogue of Beilstein, has already proved to be invaluable to organic chemists. In some ways Elsevier is superior to Beilstein, although the reputation of Beilstein for its comprehensive and dependable character is so great and well deserved that the relative merits of Elsevier can only be judged after a few years of use by many organic chemists interested in organic compounds of varied types. Elsevier has the advantage of being much more up to date; supplementary volumes of Beilstein do not cover the literature after 1920-27, and in view of the pace of progress in organic chemistry during 1920-50, the importance of an Encyclopædia which covers the literature up to (and in later volumes beyond) 1942 is obvious. In the present volume the literature till the end of 1944 has been consulted and, so far as the structure of compounds is concerned, the literature survey actually extends into the beginning of 1950. Each volume has a subject index and a formula index, the latter being particularly useful because the decennial indices of chemical abstracts do not include formula indices. The paper, printing and binding are superb; structural formulæ are set up very clearly. The arrangement of the subject-matter is excellent; with the aid of the subject and formula indices a compound can be located very readily. The description of each group of compounds begins with a useful summary. The data on the more important compounds includes physiological properties, methods of identification and analysis, and applications in analytical chemistry. To cite only one example of the scope of the information which is provided by Elsevier, the preparation and properties of β-naphthol (exclusive of its derivatives) are described in 40 pages which constitute a remarkably complete monograph on the substance.

Of the 18 volumes (plus Vol. XIX: subject index and Vol. XX: formula index) which are

to comprise Elsevier's Encyclopædia, Vols. XIV and XIII, Vol. XII-A and Vol. XII-B, Parts 1 and 2, have so far appeared. The book under review is the third part of XII-B, dealing with the hydroxy derivatives of naphthalene containing one or more hydroxyl groups in the nucleus or the side chain. The naphthoquinones and their derivatives, hydroxynaphthoic acids and naphtholsulphonic acids are not included in the part under review, except for incidental references as in the sulphonation of the naphthols, and further parts of Vol. XII-B will be awaited with interest. Organic compounds in patent literature are to be dealt with in additional volumes, but the logic of this procedure is difficult to see. Because of the greater labour involved in classifying the organic compounds described or mentioned in the patents of various countries, it was probably necessary to postpone this task in order to ensure that the publication of successive volumes of the Encyclopædia, already behind schedule, is not unduly delayed; but for the chemist who wishes to know if a compound is new and to have the fullest information on known compounds, the availability of all the data on a given compound and its derivatives in a single place would be a considerable simplification of his work.

Elsevier's Encyclopædia represents a service of the utmost importance to international progress in organic chemistry, and it is to be hoped that a way will be found for amalgamating further volumes of Beilstein and Elsevier.

K. V.

1948 Annual Report of the Nutrition Research Department of Health, O.S.R., Djakarta, Indonesia.

The Report deals with the activities of the Nutrition Research Institute for the year 1948. The fact that the directorship of the Institute changed hands twice during the year is symptomatic of the effects which the disturbed post-war political conditions had even on the working of scientific institutes in Indonesia.

The Report is of particular interest to countries of the South East Asian Region. The conditions in most of these countries are similar economically and, to a certain extent, politically as well. Nutritional problems facing them are also of the same pattern as was clearly shown at the Far Eastern Nutrition Committee meeting held under the auspices of the F.A.O. at Baguio in 1948 and in Rangoon in 1950. It is, therefore, worthwhile making a note of the difficulties which National Nutritional Institutes may have to meet in undertaking and pushing through programmes of nutritional studies and development. Most of the latter are handicapped at the start by lack of (*a*) trained personnel, (*b*) adequate funds and (*c*) desire on the part of the Governments concerned to consider health based on proper nutrition as a prerequisite for national development.

The Nutrition Research Institute of Indonesia is happily placed on account of its association with the Eijkmann Institute of international fame. In several other countries, no nutrition institutes exist and where they have recently been started they still continue to suffer from the effects of the disturbed economic and political conditions after World War II to be able to play an effective role in the fight against malnutrition. Nevertheless the Report under discussion gives hope that one may expect in the near future fulfilment of the projects undertaken in Indonesia and that the work of this and other infant institutes in South East Asia will act as an incentive for other countries of the region to take steps in the right direction.

V. N. PATWARDHAN.

OBITUARY

RAO SAHEB T. P. BHASKARA SASTRY

RAO SAHEB T. P. BHASKARA SASTRY, a pioneer of modern Indian Astronomy and formerly Director of Nizamiah Observatory, Begumpet, died on 26th June, 1950, at the age of sixty-one.

Sri. Bhaskara Sastry was born on 12th April 1889, at Thiruvadamaruthur in the Madras Presidency. Soon after his graduation from the Madras University in 1912, he joined the Nizamiah Observatory, Begumpet, as an Assistant and became its Director in 1922 and continued as Director till his retirement in 1944.

Under his care and guidance, the Observatory completed the Carte-du-Ciel programme of photographing certain zones of the sky allotted to it by the International Astronomical Union. His work in this connection was recognised by the astronomical world and he was co-opted a Member of the Carte-du-Ciel Commission of the International Astronomical Union. Besides astronomy, he was also interested in seismology and meteorology.

He was a Fellow of the Royal Astronomical Society, the Indian Academy of Sciences and the National Institute of Sciences of India.

A. A.

SCIENCE NOTES AND NEWS

Cosmic Ray Research on the Swiss Alps

Four Manchester University cosmic ray scientists are to winter at a research station on Jungfraujoch in the Swiss Alps to continue their research into the properties of "Taumesons". These are showers of newly discovered and very penetrating particles produced when the atom is broken by cosmic rays.

The Jungfraujoch experiments are a continuation of the cosmic ray research which has been carried out by Manchester University since before the war. The party's equipment will include a 14-ton magnet and apparatus to photograph the tracks of nuclear particles.

Mr. J. A. Newth will lead the team, which is expected to arrive at Murren (Switzerland) in October and commence its researches about the end of November. It will work under the direction of Prof. P. M. S. Blackett.

A party from Bristol University under Prof. C. F. Powell will photograph radio-active particles by a new method.

Common Names for Pest Control Products

The British Standards Institution now announces that the Technical Committee appointed to devise simple, common names for well-established pest control products (including insecticides, insect repellents, acaricides, nematocides, fungicides, herbicides and rodenticides) has prepared the first list, containing some 25 common names for the better-known products now in general use in agriculture and in veterinary circles throughout the country. This list is being circulated for technical comment among Government departments, manufacturers and the interested scientific societies before final publication. In order to pre-empt the use of these names as proprietary names, the list has been lodged with, and approved by H. M. Patent Office. The names will be given protection and will be referred to when application is made for the registration of proprietary names for pest control products.

Wherever possible, the names adopted conform with those already accepted as coined common names by the U.S. Department of Agriculture, and the same system of protection is given by the U.S. Patent Office. It is hoped that the same measures will extend to other countries in due course.

Raised Price Limit for Purchases of Scientific Material

The price limit for purchases of scientific material with UNESCO coupons, which was originally set at $ 500, has now, as a result of the meeting held in Florence on 13th June, been raised to $ 1,000.

Geological, Mining and Metallurgical Society of India

Officers and Members of the Council for 1950-51:—*President*: Dr. W. D. West; *Vice-Presidents*: Mr. M. K. Ray, Mr. B. P. Agarwala; *Joint Secretaries*: Prof. N. N. Chatterjee, Prof. N. L. Sharma; *Treasurer*: Prof. P. C. Datta; *Librarian*: Mr. Arun Kumar Roy; *Other Members of the Council*: Mr. S. K. Barooah, Mr. D. K. Chakravarty, Dr. M. Chatterjee, Mr. N. K. N. Iyengar, Mr. V. G. Iyer, Dr. C. Mahadevan, Mr. L. Rama Rao and Mr. Y. Nagappa.

Research Degree Award

On the recommendation of the Board of Examiners appointed to adjudicate on the thesis entitled, "Investigations on the Raman Effect", the Syndicate of the Madras University have declared Mr. P. K. Narayanaswamy, M.Sc., a student of the Physics Department of the Indian Institute of Science, qualified for the degree of Doctor of Philosophy.

National Campaign Against Malaria

A large-scale campaign to combat the ravages of malaria in India, where new cases are estimated at 2,400,000 yearly, has been started by the Government in co-operation with the World Health Organization (W.H.O.) and the United Nations Children's Emergency Fund. Teams of foreign experts are already working in the States of Uttar Pradesh, Mysore, Madras and Orissa. W.H.O. is providing technical personnel and advice, and the U.N. fund is furnishing equipment for the campaign.

Measures being taken include the treatment of malaria sufferers, examination of children, spraying of houses with DDT, and efforts to prevent the breeding of mosquitoes by filling or draining ditches. The Indian Government also aims to develop the pharmaceutical industry and to provide the quinine needed for the treatment of malaria victims.—(UNESCO.)

Editor: M. Sreenivasaya, B. A., F.I.I.Sc., F.A.Sc.,
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3. Miscellaneous Bulletin No. 69—Estate Farming in India; Pp. 99 with 36 plates; Price Rs. 2-4.

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2. Bulletin No. 60—Preparation of Compost Manure from Town Wastes, by C. N. Acharya; 4th edition (Revised).
3. Scientific Monograph No. 17—Poisonous Plants of India, by R. N. Chopra, Badwar and Ghosh.

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